electronics

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International

IRE *Special*

New Concepts in Technology

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Space Probe Power Supplies

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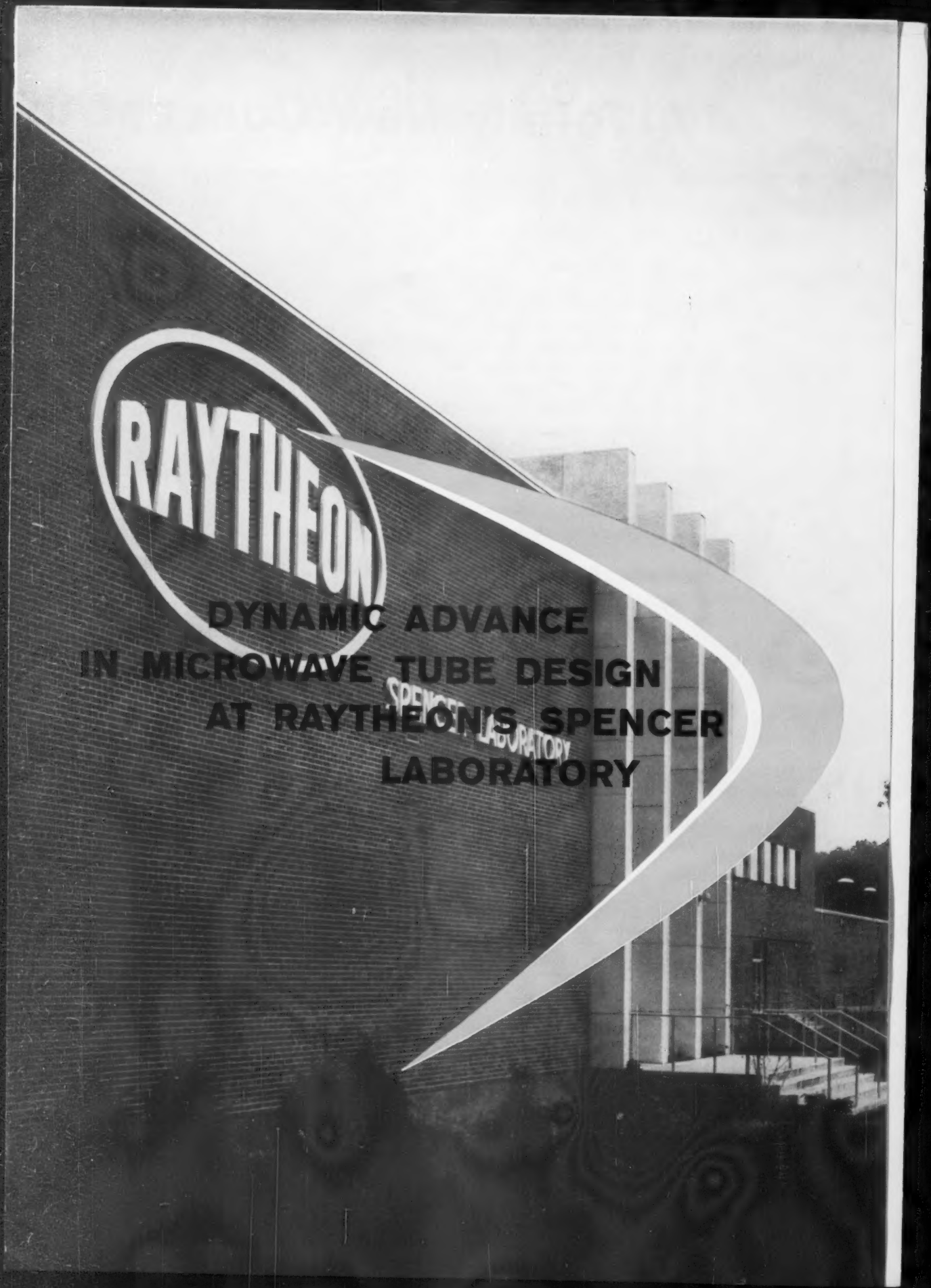
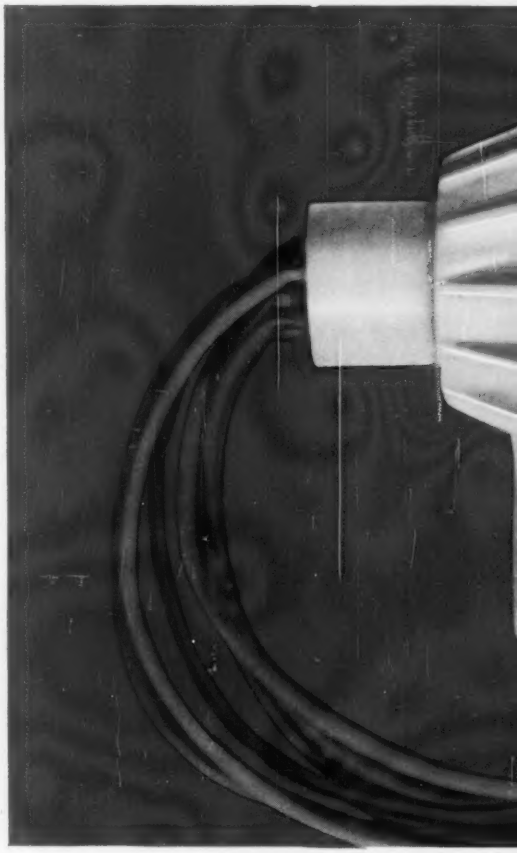

RAYTHEON
DYNAMIC ADVANCE
IN MICROWAVE TUBE DESIGN
AT RAYTHEON'S SPENCER
LABORATORY

A Totally New Concept in

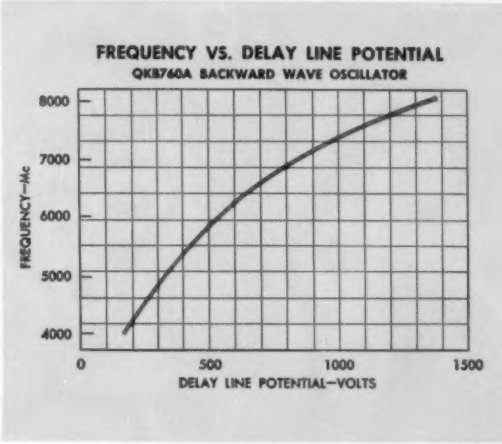
Interdigital-type delay line affords maximum heat dissipation at high power outputs

These broadband voltage tunable backward wave oscillators are the smallest, lightest and most reliable of their kind. They were developed especially for modern airborne and ground-based applications utilizing swept oscillator and frequency diversity techniques. Four compatible types are available. They cover a continuous frequency range of 1 to 12.4 KMC. They are magnetically shielded and are insensitive to the effects of external fields. They exhibit a minimum of fine-grain power output variations. Potted leads permit operation at high altitudes over a wide temperature range. Raytheon-perfected laminating techniques make possible interdigital construction which results in maximum heat dissipation. Under normal operating conditions, no forced-air cooling or protective circuitry is required. Laminate-thickness held to extremely close tolerances assures improved fine-grain frequency characteristics with optimum line matching and consistently reproducible characteristics from tube to tube.



7 RAYTHEON FEATURES

1. Continuous frequency coverage in four compatible types, 1 to 12.4 KMC
2. Smoother tuning curves (improved fine-grain tuning variations)
3. Minimized fine-grain power output variations.
4. Reduced weight—smaller size
5. Much less sensitive to external magnetic fields
6. No forced-air cooling required under normal operating conditions
7. Rugged construction for operation in extreme environments.

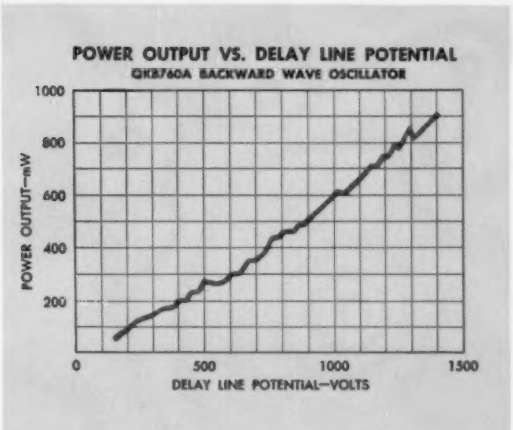


Sample tubes will be available after May 1. For detailed application information and special development services call Raytheon in Burlington, Mass., at Browning 2-9600. Ask for Al Vacaro. Or call any one of the following Raytheon field representatives: In New York: Wisconsin 7-6400. In Baltimore: Southfield 1-0450. In Chicago: National 5-4000. In Los Angeles: Normandy 5-4221. In E. Waterloo, Ontario: Sherwood 5-6831.

See the tubes at the IRE Show

in "O"-Type BWO Construction

QKB 760A Backward Wave Oscillator



TUBE TYPE	QKB786	QKB816A	QKB760A	QKB776
Frequency Range	1.0-2.0KMC	2.0-4.0KMC	4.0-8.0KMC	8.0-12.4KMC
Power Output	100 mW Min.	70 mW Min.	30 mW Min.	50 mW Min.
Delay Line (Tuning) Voltage	100-1500 Vdc			
Filament Voltage	6.3 V.			
Cathode Current	45 mA Max.			
Anode Voltage	60-150 Vdc	100-200 Vdc	60-130 Vdc	60-130 Vdc
Control Grid Cut-Off	-150 Vdc	-100 Vdc	-100 Vdc	-100 Vdc
Fine-Grain Power Output Variation	±0.5 db			
Tuning Curve Linearity	±1.0 Mc			
Tuning Curve Repeatability	±2.5%			
Input Connection	Color Coded Insulated Leads			
Output Connection	Type N Coax			Waveguide RG52/U
Weight	11 lbs.	6.5 lbs.	6.5 lbs.	5.0 lbs.
Shock	30 G's			
Vibration	10 to 55 cps at .08" displacement and 55-500 cps at 20 G's			
Life	1000 hrs.			

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electronics

MARCH 11, 1960

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Vol. 33 No. 11

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this standing wave amplifier defies comparison

FEATURES:

- A new low in noise levels — down to 0.007 μv providing 0.02 μv full scale sensitivity at minimum bandwidth.
- 5 db steps
- Attenuation range of 85 db
- FOUR regular VSWR scales plus one expanded
- All meter scales automatically normalized when switching ranges
- Large 5¾" meter with 1% linearity
- Continuous gain control over 15 db range
- Continuously variable bandwidth control
- Front panel meter monitors bolometer bias current

SPECIFICATIONS:

Frequency: 1,000 cps; adjustable over a 2% range.

Sensitivity: 0.02 μv at minimum (4 cps) bandwidth. 0.1 μv at maximum (40 cps) bandwidth.

Noise Level: 5db below full scale (0.007 μv at minimum bandwidth).

Amplifier Q: 250 at 4 cps; 25 at 40 cps.

Bandwidth: Continuously variable from 4 to 40 cps.

Calibration: Square Law. Meter reads SWR, db.

Range: 85 db. Input attenuator provides 70 db in 5 db steps. Gain control provides 15 db adjustable. Accuracy ±0.1 db per 10 db. Maximum cumulative error of ±0.2 db at 40 cps bandwidth.

Scale Selector: Expanded, Regular, and Bolometer Current. Meter scale always normalized when switching from scale to scale or from expanded to regular.

Meter Scales: SWR: 1-4; SWR: 1.8-6; SWR: 3.2-10; SWR: 6-15; Expanded SWR: 1-1.3; db: 0-10; Expanded db: 0-2.3.

Input Selector: 220,000 ohms; Crystal; Bolometer. Bias provided for high 8.4 ma bolometer or 4.3 ma low current bolometer. Bias adjustable ±15%. A bolometer protective circuit permits any switching operation or cable connect-disconnect without damage to bolometer.

Output: Jack for 1500 ohm recorder, 1 ma full scale deflection.

Input Connector: BNC Jack.

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CROSSTALK . . .

International IRE

THE FUTURE OF ENGINEERING. The 1960's will see a number of changes in engineering, if today's trends are a barometer.

There will be more stress on international exchange of information. Unlike political separation of the world, which sees East vs West, research continues to be the province of men everywhere. It is significant that the IRE is referring to itself more frequently as an international organization. Displays and technical sessions at the New York show will reflect this.

The coming cut across geographic lines is accompanied by a cut across lines that have sometimes divided the Institute from other technical societies. It seems clear the expanding scope of the world of electronics must lead to more interchange with many other groups.

A most significant trend is the increased sharing of knowledge in many areas of science. The physicist, the biologist and the chemist are turning increasingly to the electronics engineer for new solutions, for new research areas and for new equipment. And vice versa.

The electronics expert must move farther and farther away from what once was his home base to keep pace with prime needs, fulfilling —through electronics—requirements of the world in which he lives.

Increased interchange of information is doing something else for the engineer. Slowly, the image he forms in the public eye is changing. He is becoming less of an accumulator of information and producer of mysteries—and more of an important individual doing his share to bring a better world into being, in cooperation with those about him.

W W MacDonald

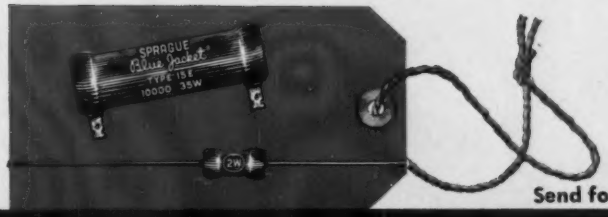
Editor

Coming In Our March 18 Issue . . .

SILENT SENTRY. In recent wars, the frequency of night combat led to greater reliance on electronics for increasing the range and accuracy of detection methods without revealing position. Next week, J. Scott, D. Randise and R. P. Lukacovic of Sperry Gyroscope describe a portable Doppler radar that will soon be available in production quantities for field use.

Known as the AN/PPS-4 Silent Sentry, the 50-pound radar can detect a walking man at one mile and a large moving vehicle at four miles in mist or darkness. A magnetron produces 0.2-microsecond pulses of X-band r-f energy which are concentrated into a six-degree beam by a dipole antenna and parabolic reflector. The return signals are used to produce distinctive sounds in a pair of headphones. The target's range, azimuth and elevation are displayed.

MILLIMETER-WAVE AMPLIFIERS. Decreasing spectrum space and noise problems are pushing communications frequencies into the millimeter-wave region. In an effort to fill the gap in receiving amplifiers available at these frequencies by using commercially available components, K. Ishii of Marquette University has found a way to use M-band reflex klystrons as millimeter-wave amplifiers. In his article next week, Ishii describes how the reflex klystron, which is essentially an oscillator, can be used as a regenerative amplifier by carefully adjusting the output circuit impedance.



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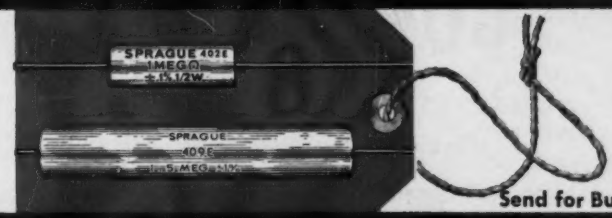

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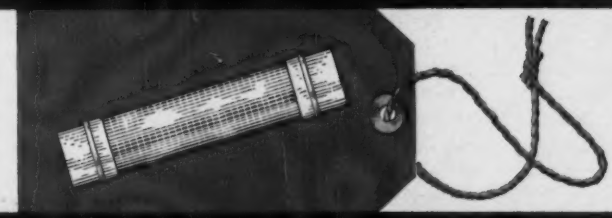

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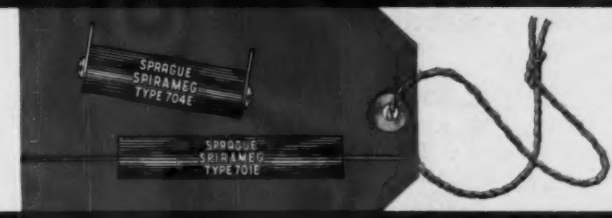

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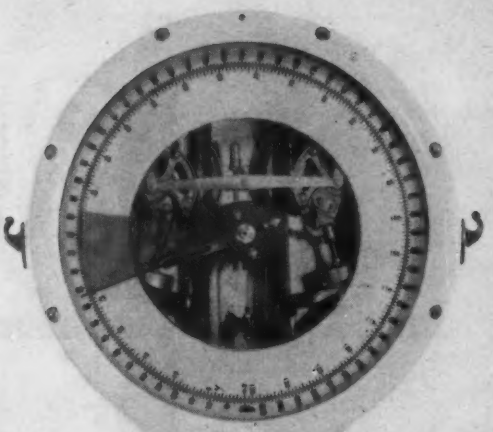

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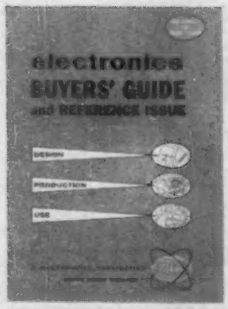

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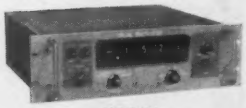
MODEL 840
DC Volts/DC Ratios

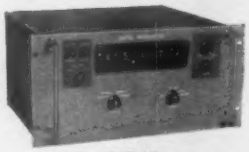


MODEL 841
DC Volts/DC Ratios/Resistance

MODEL 842
DC Volts/DC Ratios/AC Volts

MODEL 843
DC Volts/DC Ratio/AC Volts/Resistance

MODEL 844
DC Volts/Ratio/DC Pre-Amplifier



MODEL 845
DC Volts/Ratio/Resistance/DC Pre-Amplifier

MODEL 846
DC Volts/Ratio/AC Volts/DC Pre-Amplifier

MODEL 847
DC Volts/Ratio/AC Volts/Resistance/Pre-Amplifier

MODEL 848
DC Volts/Ratio With Electrical Outputs

MODEL 849
DC Volts/DC Ratios/Resistance With Electrical Outputs

MODEL 850
DC Volts/DC Ratios/AC Volts With Electrical Outputs

MODEL 851
DC Volts/DC Ratio/AC Volts/Resistance With Electrical Outputs

MODEL 852
DC Volts/Ratio/DC Pre-Amplifier With Electrical Outputs

MODEL 853
DC Volts/Ratio/Resistance/DC Pre-Amplifier With Electrical Output

MODEL 854
DC Volts/Ratio/AC Volts/DC Pre-Amplifier With Electrical Outputs

MODEL 855
DC Volts/Ratio/AC Volts/Resistance Pre-Amplifier With Electrical Outputs

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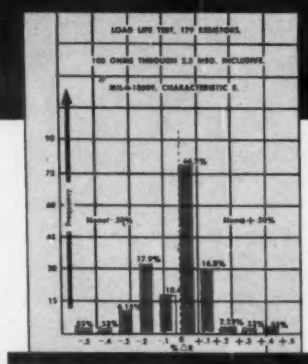
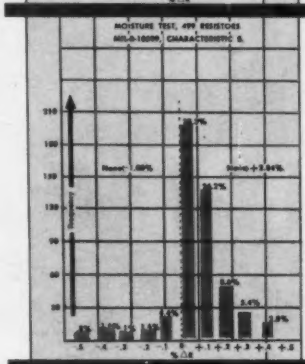
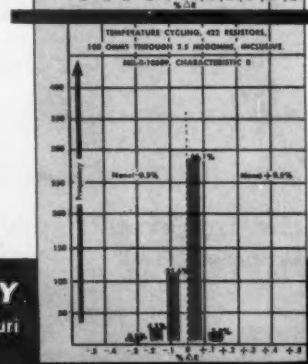


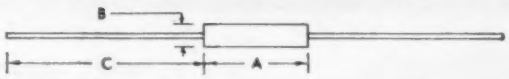




Check at right the histograms showing test results on the new Electra Precision Carbon Film Resistor. See for yourself the remarkable ability of this resistor to withstand extreme conditions of heat and humidity, also its exceptional load life. Primary credit for these outstanding characteristics goes to Electra's exclusive new Type R-5 coating, developed in our laboratory after a long period of scientific study and experimentation. But performance alone is not the whole story. Check, too, the sizes; truly, this resistor opens up a whole host of new possibilities in your design and engineering work.

Electra Part No.	Mil Style	Wattage Mil. 70°C	Wattage EKC 70°C	Wattage EKC 125°C	Mil Resistance Range	Manufactured Resistance Range	Max. Rated Voltage	Length A ±1/32	Dia. B ±1/32
CF 1/8	RN60B	1/8	1/4	1/8	10 Ω 1 Meg	10 Ω 1 Meg	250	.375 +1/16 −1/32	.125 +.040 −.010
CF 1/4	RN65B	1/4	1/2	1/4	10 Ω 2 Meg	10 Ω 2 Meg	300	.625 +1/32 −1/16	.1875 +1/16 −1/32
CF 1/2	RN70B	1/2	1	1/2	10 Ω 2.5 Meg	10 Ω 5 Meg	350	.750 +3/32 −1/16	.250 +1/16 −1/32

Lead length C, 1½ for all, ±1/8. Dia. leads, #22 for CF 1/8 and CF 1/4, #20 for CF 1/2.



WRITE FOR NEW BROCHURE—Just off the press... new brochure describing Electra's complete line of precision carbon film resistors. Electra also manufactures a complete line of precision metal film resistors and ceramic disc and plate capacitors. **SEE ELECTRA DISPLAY AT I.R.E. SHOW BOOTH NO. 2834-2836**

Electra MANUFACTURING COMPANY
4051 Broadway · Kansas City, Missouri

BUSINESS THIS WEEK

This Year's IRE Show: Record Registration, More Technical and Applications Emphasis

The 1960 Institute of Radio Engineers International Show and Convention is expected to attract some 65,000 persons—5,000 more than last year—with a greater attendance at technical sessions than ever before. It runs from Mar. 21 to Mar. 24.

The show at New York's Coliseum will be largely one of components—which cover two out of four floors—but there is expected to be more large equipment, such as computers, on display than in other recent shows. **Many papers will give new evidence of the widening market horizons of electronics,** reporting on such topics as agricultural applications, supermarket automation using machines for price numeral recognition, ultrasonic welding and thermoelectric converters.

If previous experience is any criterion, slightly more than half of the show visitors will be working engineers. About one-sixth will be management men. Almost one-fifth will be sales and advertising men and purchasing agents.

As for the character of the organizations represented in the show registration, electronics manufacturers will send more than half of the persons attending—including both engineers and salesmen. More than 10 percent will be consulting engineers and representatives of R&D firms. Less than 10 percent will be employees of industrial users of electronic gear and manufacturers of non-electronic equipment. A smaller percentage will represent jobbers, and service and installation organizations. Slightly more than five percent will be teachers and students; a little less than five percent will be government and military observers.

Navy's Corvus Carrier Aircraft Missile, With Passive Radar Guidance, Gets Contract Push

Navy's Corvus air-to-surface attack missile gets a new push with a $25 million allocation to weapon system prime contractor Temco Aircraft Corp., Dallas, Tex. It is believed that the W. L. Maxson Corp., New York City, will receive a subcontract in excess of $3 million for continuation of earlier development work on the passive radar guidance system, and for production of test units.

Corvus, a stand-off missile for carrier aircraft, is launched by the pilot and involves tuning equipment aboard the plane and a radar receiver on the missile for homing. **Maxson has been engaged for some time in developing the nose cone and the complete front-end r-f portion of the system. Texas Instruments Inc. is developing the associated error detection computer.**

Flight tests are centered at the Navy's Pacific missile range, Point Mugu, Calif. A test version of the Corvus was first successfully air-launched by an A4D Skyhawk last July.

Space Agency Seeks Supplemental '60 Funds Of $19 Million to Spur Man-in-Space Program

National Aeronautics and Space Administration's T. Keith Glennan has requested $19 million in supplemental funds for Project Mercury beyond the fiscal 1960 budget of $74,962,000 for the man-in-space program. The additional request for Mercury came out during Glennan's appearance before the Senate Committee on Appropriations recently. He requested a total supplemental appropriation of $23 million over the agency's fiscal 1960 budget of $500,575,000.

The $19 million for Mercury breaks down this way: $12.2 million in R&D funds for improvements in capsule design, construction and instrumentation, and $6.8 million for the tracking and data-collection network. Specifically, the latter covers supplemental instrumentation and facilities at the 16 Mercury stations, including the Atlantic missile range control center; and facilities at the Navy's Pacific missile range and its Kauai Island, Hawaii installation.

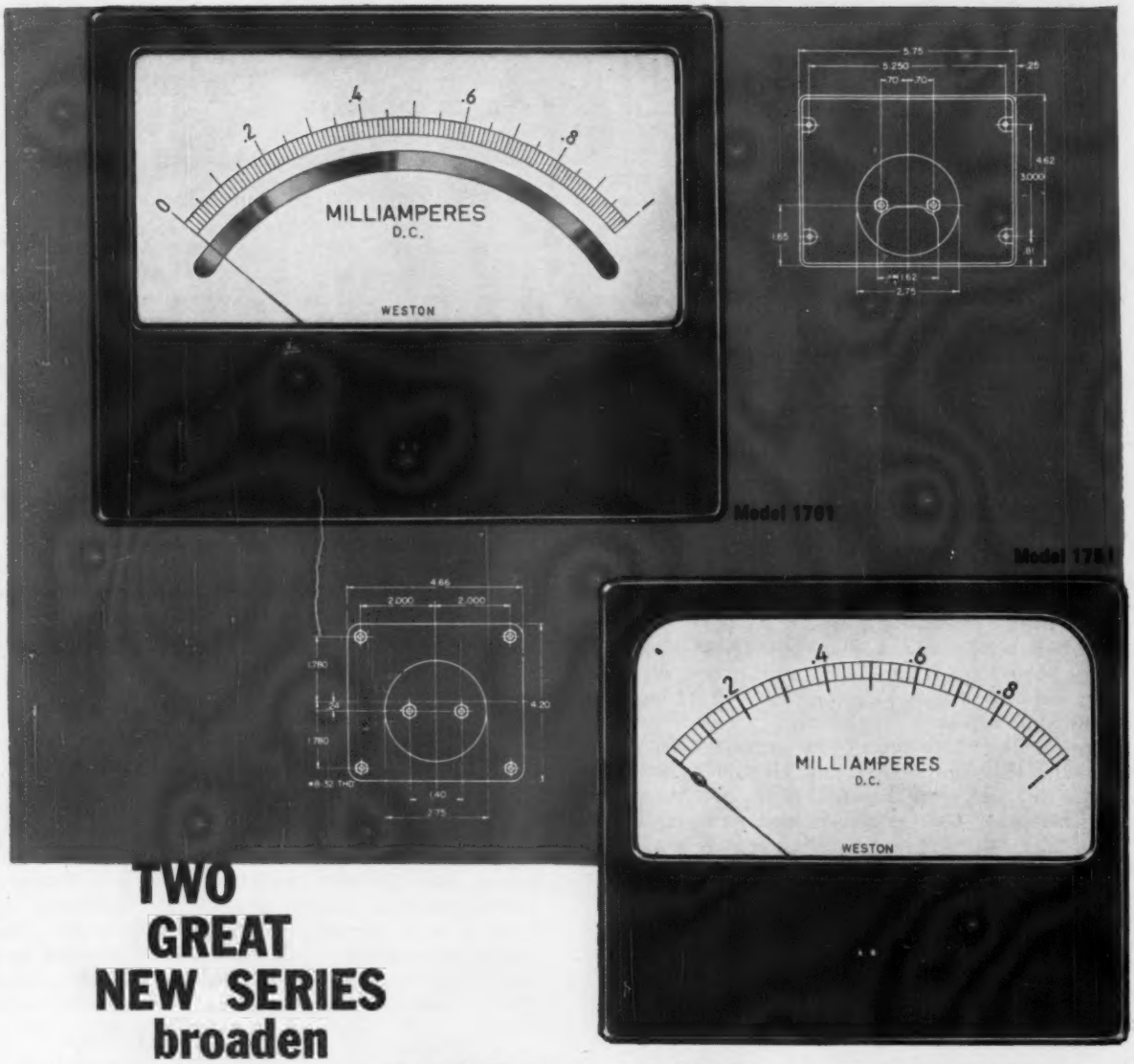
ELECTRONICS NEWSLETTER

Soviet exhibit at the Feb. 28-Mar. 4 Leipzig trade fair in East Germany focused on new electronic instruments and measuring apparatus, automation and space. East Germany, Czechoslovakia and Hungary also displayed a variety of electronic equipment. It adds up to a new place for electronics in the Communist propaganda drive for scientific prestige and an attempt to open a wider avenue for electronics trade between the Communist states and Western Europe.

American exports of precision measuring instruments to 130 countries amounted to $279 million in 1959, $7 million more than in the previous year, and represented one-twelfth of total U.S. production, according to the Business and Defense Services Administration.

In development of high-speed pulse power resistance welding systems, misfiring has been a major stumbling block. Now, Robotron Corp., Detroit, says this has been overcome by its new "spike power" welding control unit. In the system, in which welding current is applied in short bursts every half-cycle of the timing frequency, the capacitor charge system develops up to 120 spikes per second without misfiring. The company says successful applications of the process to welding of dissimilar metals has been achieved.

Radio amateur licenses in the U.S. now exceed 200,000 and the number of amateur station licenses approaches 204,500, according to the FCC. The commission says "ham" licenses have jumped 285 percent in 12 years.



TWO GREAT NEW SERIES broaden world-famous WESTON panel instrument line

These advanced rectangulars represent a new high in value for the panel instrument user. Both series feature the exclusive Weston CORMAG® moving coil mechanism. They may be mounted on magnetic or non-magnetic panels without special adjustment . . . are immune to the effects of stray fields and nearby instruments. Cases and covers are of rugged molded bakelite. Large window area assures optimum readability—scales cover a full 100° arc.

The 1751 series offers accuracies within ±2% of range for all D-C models . . . ±3% for rectifier type A-C instruments used on sine wave 60 cycle source at room temperature. The 1761 group provides standard accuracies of ±1%. Accuracies within ±½% are also available when equipped with knife edge pointers and mirror scales.

For full information, or for the address of your nearest distributor, contact your local Weston representative . . . or write to Weston Instruments Division, Daystrom, Incorporated, Newark 12, N. J. *In Canada: Daystrom Ltd., 840 Caledonia Rd., Toronto 19, Ont. Export: Daystrom Int'l., 100 Empire St., Newark 12, N. J.*

Visit us at the Daystrom Booths • IRE Show • New York Coliseum • March 21-24

DAYSTROM, INCORPORATED
WESTON INSTRUMENTS DIVISION

World leader in measurement and control

NOW...every volume tester of semiconductor devices can profit with SMART

(TI's Sequential Mechanism for Automatic Recording and Testing)

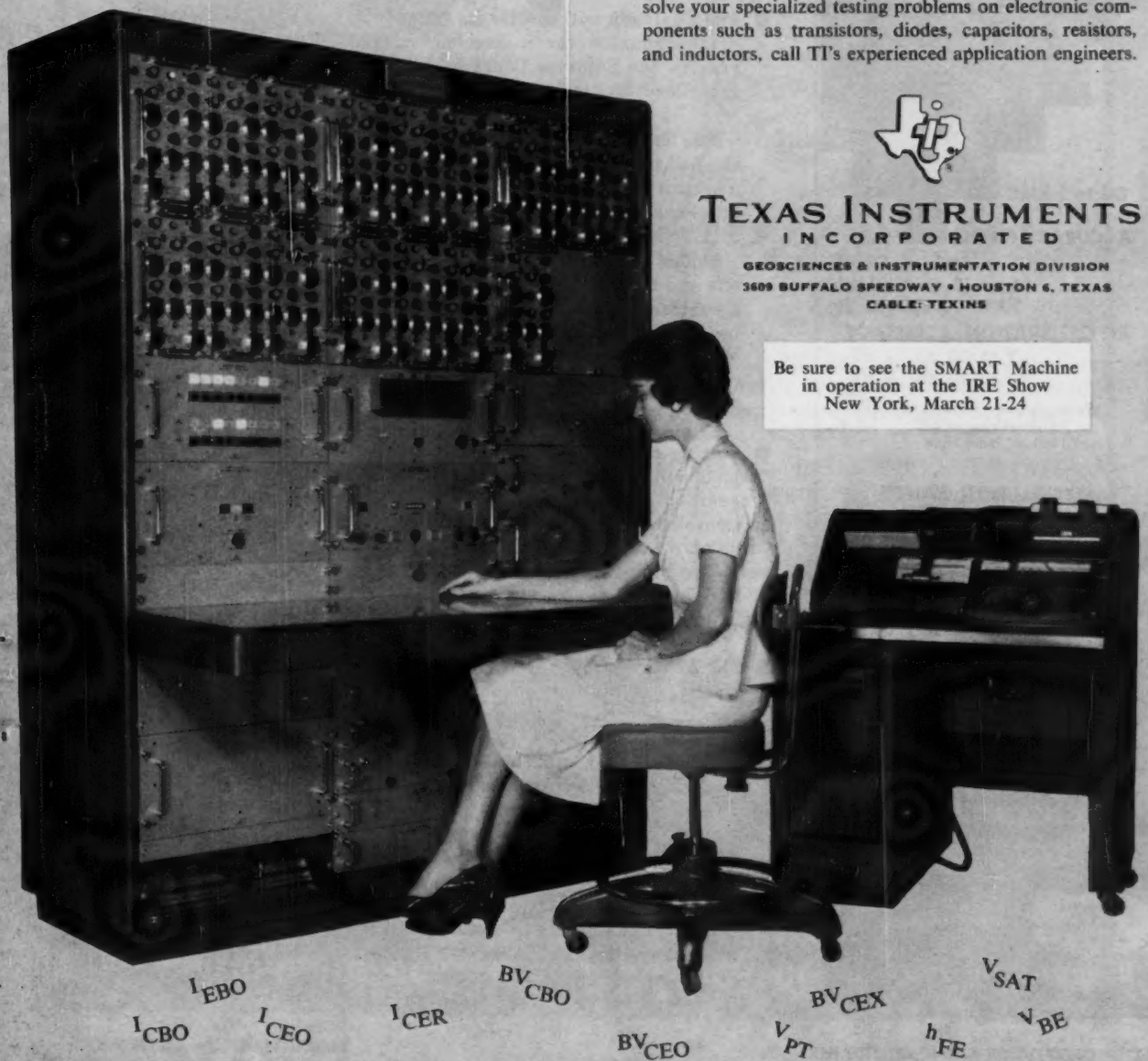
This new automatic testing-recording system offers you greater speed, more consistent accuracy, and lower unit testing costs than are obtainable by any hand testing means. Whether your requirements are Engineering Studies, Quality Assurance, Quality Control or Reliability Testing of semiconductor devices, SMART will add greatly to the efficiency of your operation.

The standard SMART machine enables you to measure up to 16 different d-c parameters of a transistor or other semiconductor device and record these data within 12 seconds. A minimum time of .5-second is required to test each parameter and an additional .2-second records the intelligence on an IBM 526 Summary Punch or other digital recording device. Using all 16 parameters, of course, 300 transistors may be tested per hour; however, fewer parameters would be desired on most testing runs and upwards of 500 semiconductors/hour could be handled easily.

Sixteen programming modules permit you to skip, hold, or delay individual tests as well as control the level of biasing supplies. You may record actual parameter values or set the machine for rejection limits only. Overall system accuracy is 1% of full scale readout.

The highly versatile SMART, with auxiliary consoles, may also be used for small signal h parameters; pulse, high frequency and power testing; and with environmental equipment in many types of factorial analyses. Also, the system may utilize scanning units for production runs, thus adding another high speed automatic feature.

Request Bulletin A-701 for additional information. To solve your specialized testing problems on electronic components such as transistors, diodes, capacitors, resistors, and inductors, call TI's experienced application engineers.



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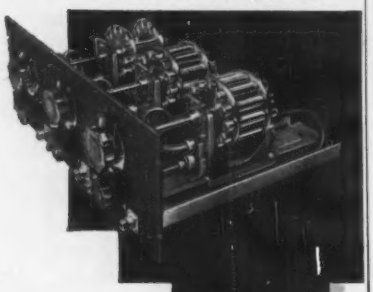
ATTENUATORS



DC to 1 KMC

ACCURACY (at DC)
1 to 5 db: .02 db
6 to 10 db: .05 db
20 to 50 db: .10 db

RF CALIBRATION ACCURACY
1 to 30 db: .1 db
40 to 50 db: .2 db

We supply individual calibrations at 400 and 1000 MC and, upon request, at other frequencies.

ATTENUATION RANGE
MODEL 60
2 drums, 0-60 db in 1 db steps
MODEL 64
3 drums, 0-64 db in .1 db steps
MODEL 640
3 drums, 0-110 db in 1 db steps

Impedance-50 ohms
Connectors-Female Type N

Long term repeatability and assured quality are a result of our experience in making coaxial attenuators with our own stable film resistors since 1947. Our facilities for attenuator calibration are the most accurate facilities available commercially.

Weinschel Fixed Coaxial Attenuators cover the frequency range of DC to 12 KMC.

Write for complete catalog, specifying frequency range of interest.

Weinschel Engineering
KENSINGTON, MARYLAND

WASHINGTON OUTLOOK

THE MUCH-TOUTED Congressional inquiry into military procurement policy, authorized in last year's Renegotiation Act extension, is turning out to be considerably less than the monumental study Capital Hill leaders originally had in mind.

The initial plan was for a hard look at all key factors in defense buying—contractors' cost estimates and allowances, pricing, profits, contracting and negotiating procedures, and other procurement policies. The intent was to come up with the first overhaul in the Armed Services Procurement Law in years and provide the basis for an intensive Congressional study into operation of the controversial Renegotiation Law.

But as the situation stacks up now, the two armed services committees are rushing through their inquiries with little intent to make serious changes in defense procurement laws. The Senate committee has held two days of hearings. The House committee plans to conduct about three hearings this month. As of now, there's no plan to call industry witnesses.

- **The Pentagon** will shortly issue new rules on security clearances for defense plant workers. Previous regulations were ruled invalid last year by the Supreme Court because of the absence of specific Congressional or Presidential authority.

  The White House has already issued an executive order to start the ball rolling on the new rules. A major change: employees denied a security clearance will get the right in most cases to confront and cross-examine their accusers.

  Under the Pentagon's industrial security program—both the old one and the new one—when a company prepares a bid or negotiates a contract involving classified defense work, its key personnel must be cleared for access to classified material. This covers principal officers, directors, top-level technicians, and the like. After the contract is awarded, all other employees who need access to the classified data must also undergo clearance.

- **Cutting components'** size and weight is helping to increase the payload and range of the Atlas ICBM. Just how much is a tightly guarded secret. But one top official says that electronics—the big item—has been miniaturized down by 50 percent in weight and 30 percent in size from first models.

  One example: the coherent carrier—the element that feeds back the down-range position of the missile—has been reduced in weight from 90 lbs to 30 lbs. And it has been cut about 80 percent in size.

- **The Pentagon** has ruled against an Army attempt to become single manager of military communications facilities. This would involve operations rather than procurement. But the operating agency, obviously, would have a big say on requirements.

  The Defense Dept., however, is still studying a means to set up centralized control over all military trunk line communications. This would not include most ship-to-shore, ground-to-air and weapon system networks. The outlook is for a joint staff, or a new agency under the Asst. Defense Secy. for Supply & Logistics, to take over the operation.

- **A tremendous demand** for licenses for Class D citizens radio (car radiotelephones connecting with home or office) is showing up at FCC. The commission is getting about 8,000 applications a month, has issued 50,000 permits since the service was established.

This new precision DC VTVM is also a wide range, precision ohmmeter and ammeter!

1% accuracy 100 μv to 1,000 volts!

Also 2% accuracy, 1 μa to 1 amp full scale.

Measures 0.02 ohms to 5,000 megohms.

No zero adjustment. 1 minute warm-up.

Floating chassis. $1,000 worth of convenience for $350!

Haven't you wished for one compact, simple instrument that would make *precision* dc voltage, dc current and resistance measurements over a wide range?

The new hp 412A is it! In its VTVM circuit, the 412A uses an exclusive hp photo-chopper instead of old-style mechanical vibrators—no drift, no 60 cps pickup. Input is floating, with resistance increasing from 10 megohms on the 1 mv range to 200 megohms on ranges above 100 mv. Current and voltage ranges have a 10 db sequence for maximum readability and overlap. The ohmmeter is a modified Kelvin bridge eliminating lead resistance error; you measure resistance accurately on hook-up wire sections as short as 6".

Model 412A also includes a 1 v or 1 ma recorder output, and 3 separate probes. Call your hp rep today for a demonstration on your bench. Price, $350.

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FIELD REPRESENTATIVES IN ALL PRINCIPAL AREAS

hp 400L LOGARITHMIC VOLTMETER—$325
New hp voltmeter covers 10 cps to 4 MC; accuracy high as ±2% of reading or 1% of full scale. Voltage range 0.3 mv to 300 v, 12 ranges, 1-3-10 sequence. Max. full scale sensitivity 1 mv. Large 5" true log voltage scale, linear 12 db scale, generous overlap. High stability, high input impedance. Also useful as amplifier for small signals, or to monitor waveforms.

hp 400H PRECISION VOLTMETER—$325
Extreme accuracy as high as ±1% to 500 KC, ±2% to 1 MC, ±5% full range. Frequency coverage 10 cps to 4 MC. Large 5" meter with precision mirror scale. Voltage range 0.1 mv to 300 v; max. full scale sensitivity 1 mv. High 10 megohm input impedance minimizes circuit disturbances. Amplifier with 56 db feedback insures lasting stability. Reads direct in db or volts.

hp 400D WIDE RANGE VOLTMETER—$225
Highest quality, extremely versatile. Covers 10 cps to 4 MC. Highly sensitive, accurate to within ±2% to 1 MC. Measures 0.1 mv to 300 v; max. full scale sensitivity 1 mv. Reads direct in dbm. High 10 megohm input impedance virtually eliminates circuit loading. 56 db amplifier feedback insures high stability and freedom from change due to external conditions.

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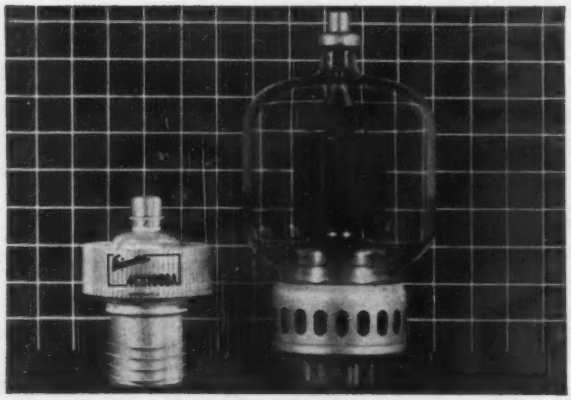
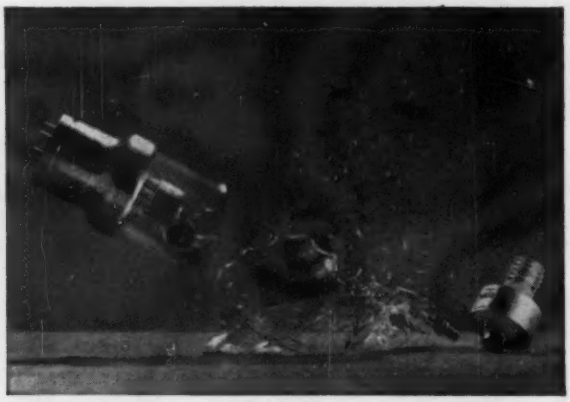
hp complete precision voltage measuring equipment

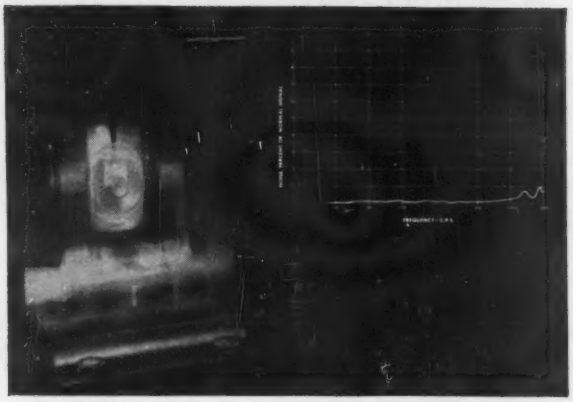
Available now—ceramic "extras" in more than 40 tube types



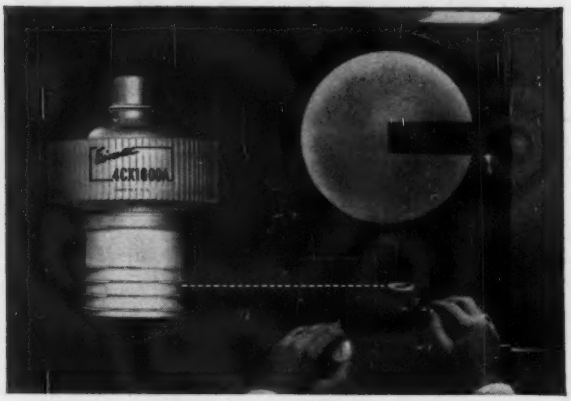
SMALLER SIZE



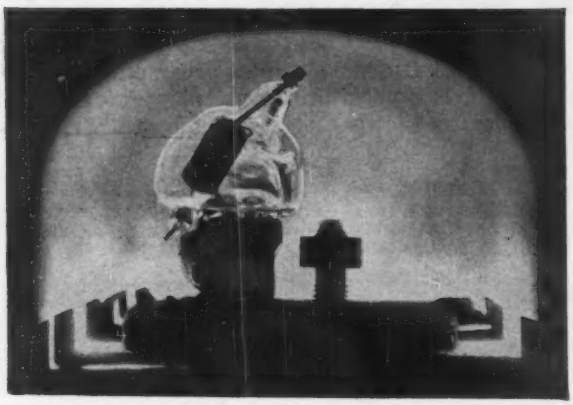
IMPACT SURVIVAL



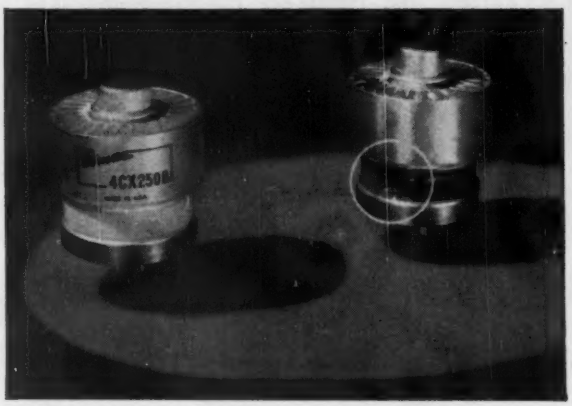
VIBRATION SURVIVAL



EXACT DIMENSIONAL UNIFORMITY



EXTREME HEAT SURVIVAL



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Superior performing Eimac ceramic negative-grid tubes and klystrons are available now for modern equipments.

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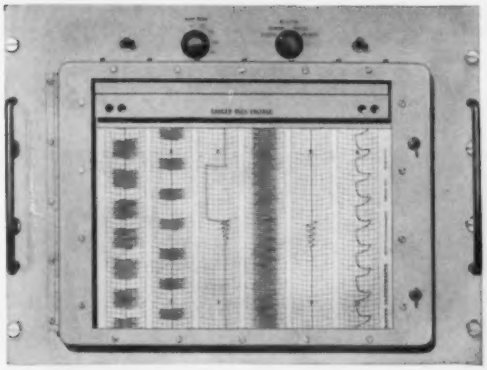
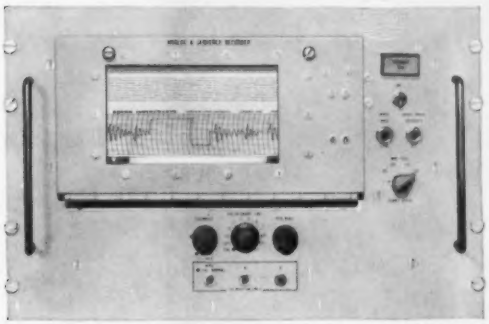
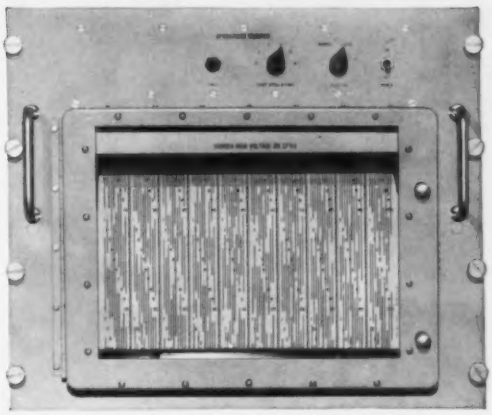
CIRCLE 17 ON READER SERVICE CARD→







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only Brush designs specifically for mil specs

From every nut and bolt to the shipping crate, fully militarized Brush Direct Writing Recording Systems are *originally* built to meet military specifications.

That's why they are performing every imaginable task of data acquisition and recording at U. S. and NATO installations throughout the world. These electric writing systems have proved their unexcelled reliability . . . from the Operations Monitor that will record 120 separate operations at the instant they occur . . . to the Analog and Sequence Recorder that simultaneously records both analog data and sequential events. And, they are built for maximum performance in the hands of non-technical personnel.

Brush equipment is already at work putting evaluation data in writing for a whole new generation of weapons. When the weapons become operational, Brush MIL Recorders are a vital part of the system. This experience is unique in the industry. *Before* prototype design becomes a problem—call, write or wire Brush for complete details.

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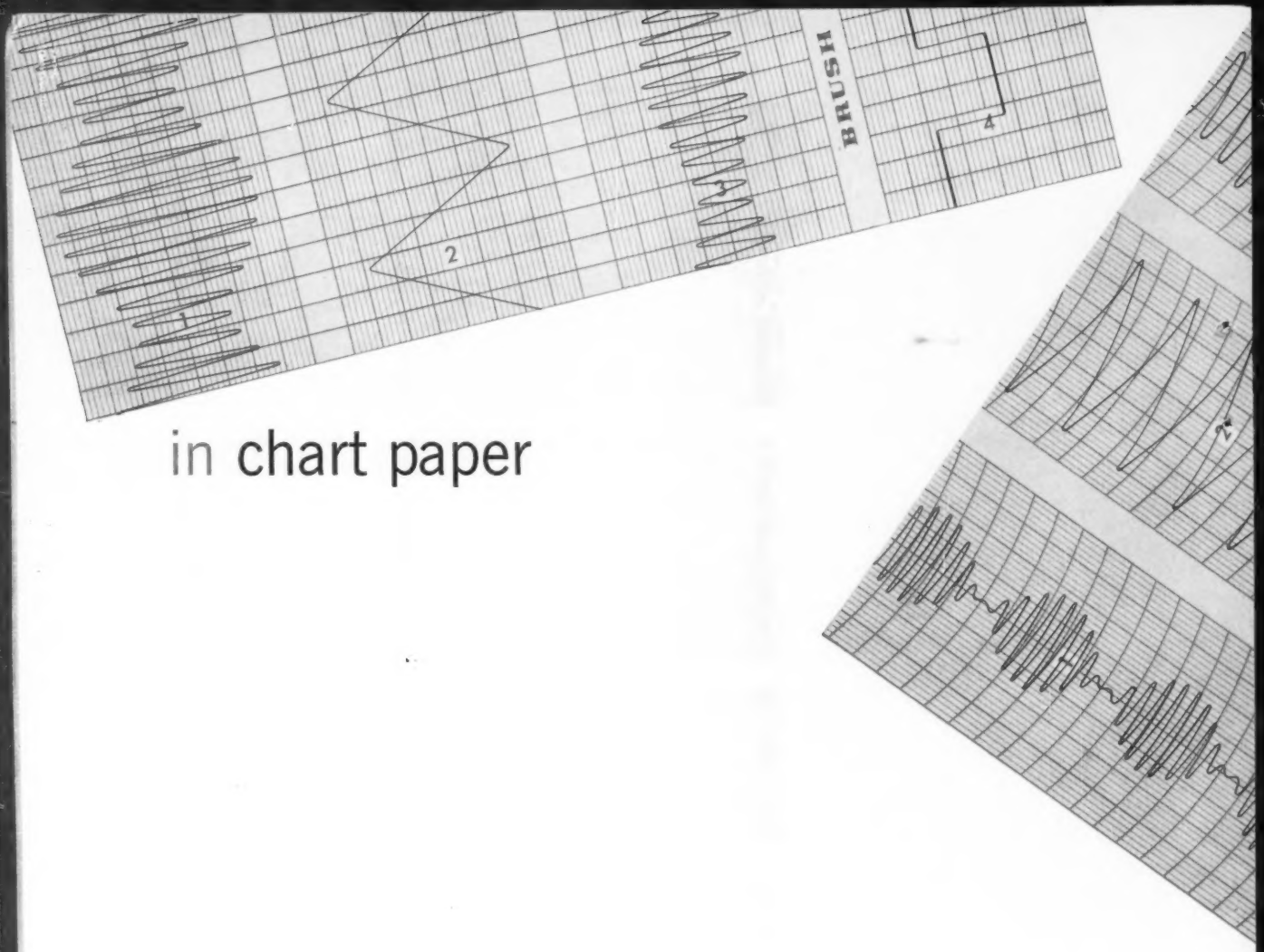

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Only Brush Chart Paper is designed as an integral component of precisely engineered Brush Direct Writing Recording Systems. The full potential of these systems cannot be realized unless *all* of the original components are utilized. They're engineered as a *total* entity. Imitation papers cannot match the precision ruling, dimensional stability and super-smoothness of Brush Chart Paper. Take no chances—specify *Brush* and you can rely on your records being accurate, permanent, easily read and easily reproduced. Stocks available from strategically located branches and sales representatives throughout the United States and Canada.

Write for samples of actual tracings on Brush Chart Paper. Ask for "Check the Record".

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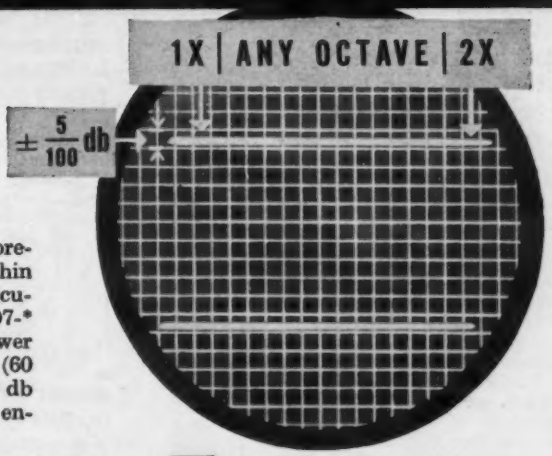
PRECISION SWEEP FREQUENCY GENERATOR model 707-*

$\frac{5}{100}$ db

ULTRA

Featuring...variable-rate, all-electronic sweep with plug-in oscillators covering 2 to 265 mcs.



The ultra flat sweep generator model 707-* is a precision instrument with an rf output that is flat within ±5/100 of a db over highest single octave. Particularly adaptable for use with an X-Y plotter, the 707-* features: plug-in oscillator heads; high output power (+20 dbm below 150 mcs.); variable sweep rate (60 per sec. to 1 per 2 min.); and harmonics down 40 db over highest single octave (down 30 db over the entire range).

*Order Model 707-1, 2, or 3 shipped respectively with oscillator heads H-71 (4-100 mcs.), H-72 (12-220 mcs.), H-73 (2-50 mcs.) **$795.00 each**

Model 707-4 shipped with H-74 (any single octave 2-265 mcs.) special order..... **$845.00 each**

Additional oscillator heads for any model 707

H-71, H-72, and H-73..... **$250.00 each**

H-74 special order..... **$275.00 each**

Write for catalog and technical Newsletter series on Measurements By Comparison using sweep frequency techniques. Prices and data subject to change without notice.

HIGH
output power—
+20 dbm

WIDE
sweep width—1% to over 120% of c.f.

FLAT
output—±.05 db over the highest octave

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←CIRCLE 18 ON READER SERVICE CARD

CIRCLE 19 ON READER SERVICE CARD

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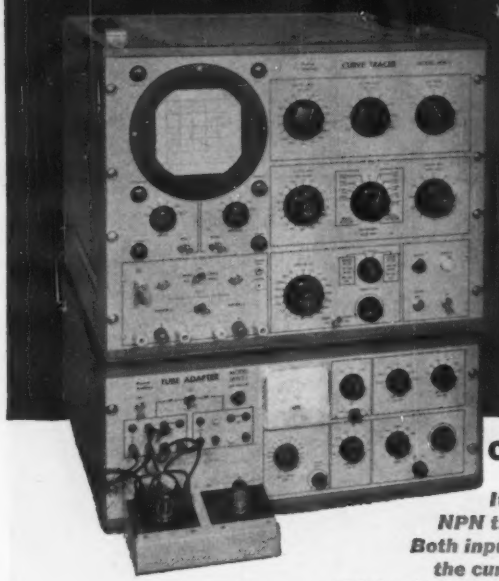
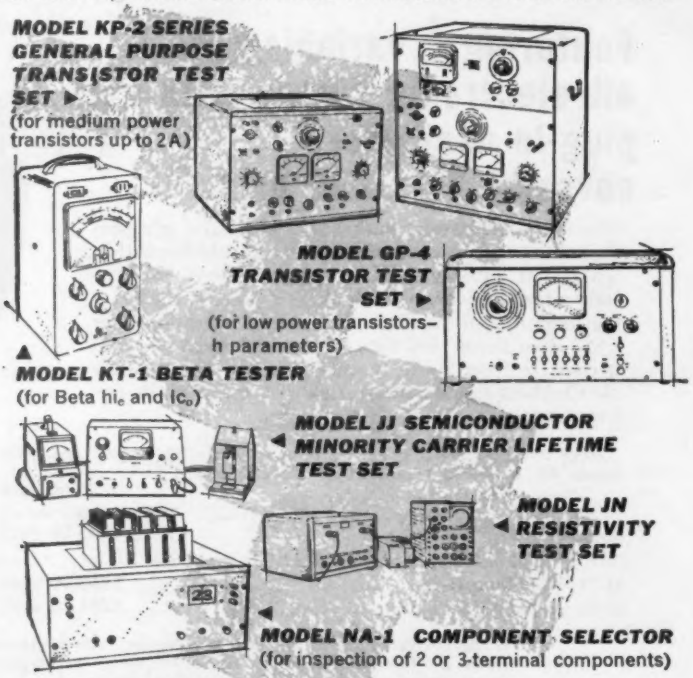
WITH THE MOST COMPLETE LINE OF TRANSISTOR & SEMICONDUCTOR TEST EQUIPMENT AVAILABLE



CURVE TRACER, MODEL MW-1 *(Shown with tube adapter)*

Baird-Atomic's Curve Tracer, Model MW-1, is the finest of its type. It is designed to display families of characteristic curves for PNP and NPN transistors in either common base or common emitter configurations. Both input and/or output current or voltage may be selected as components of the curves displayed. Its operational range includes the **highest maximums** *(30A collector current continuous duty—50A intermittent and 450 watts maximum) and the* **lowest impedances** *(minimum observed .001 ohms to 10 megohms) presently available. Maximum input drive current is 5 amperes and the MW-1 features* **automatic overload protection.** *These features make B/A's New Curve Tracer the most versatile on the market.*



MODEL KP-2 SERIES GENERAL PURPOSE TRANSISTOR TEST SET ▶
(for medium power transistors up to 2A)

MODEL GP-4 TRANSISTOR TEST SET ▶
(for low power transistors—h parameters)

▲ MODEL KT-1 BETA TESTER
(for Beta h_{fe} and I_{co})

◀ MODEL JJ SEMICONDUCTOR MINORITY CARRIER LIFETIME TEST SET

◀ MODEL JN RESISTIVITY TEST SET

◀ MODEL NA-1 COMPONENT SELECTOR
(for inspection of 2 or 3-terminal components)

For more complete technical data on BA's line of transistor & semiconductor test equipment, write to:

Baird® Atomic

Baird-Atomic, Inc.
33 University Road
Cambridge 38, Massachusetts

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AT THE IRE SHOW
BOOTHS 3219 & 3221

FINANCIAL ROUNDUP

Plans $12 Million Bond Issue

RANDOM NOTES on financial activities of electronics companies this week show many facets of change and growth. Here are some samples:

• **Collins Radio,** Cedar Rapids, Ia., has filed with the Securities and Exchange Commission a registration statement covering $12 million worth of convertible subordinated debentures. The new securities will be on a parity with an earlier issue and will be convertible into shares of Collins common stock. Proceeds will be used to increase working capital and purchase new capital goods equipment needed because of company growth. A portion of the funds will be used to reduce loans.

• **Illinois Tool Works,** Chicago, has purchased all manufacturing rights in the U. S. and Canada to the electronic module and capacitor components developed by **ACF Industries,** Alexandria, Va. Plants situated in Alexandria are also included in the transaction. Patents for special machinery, held by ACF, are assigned to the Chicago company. ACF will retain overseas marketing rights. Amount of payment involved in the transaction has not been disclosed.

• Establishment of **American Systems, Inc.,** a new company for research and development as well as manufacture of electronic systems, is announced by Schlumberger Ltd., a well surveying firm headquartered in Houston, Tex. Funds were supplied by Schlumberger in the amount of $1½ million through one of its subsidiaries, **Electro-Mechanical Research.** The new company is now setting up operations in Inglewood, Calif., and plans to place strong initial emphasis on microwave and digital data processing and display systems.

• **General Electric Co.** reports 1959 as a record year with new highs in sales and earnings. The firm's total earnings last year came to $280,242,123 or $3.19 a share. This is 15 percent above the $2.78 a share for 1958, 13 percent over 1957's $2.84 a share. Sales for 1959 were $4,349,508,529, six percent above 1958 and slightly more than the 1957 figure.

• **American Electronics Laboratories,** Philadelphia, announces signing of an agreement with **Nuclear Research Corp.,** Southhampton, Pa., granting AEL a one-year option to purchase a majority interest in Nuclear Research. The Philadelphia company manufactures communication equipment and electro-medical research gear. Nuclear Research produces gamma gages and other nuclear test equipment.

25 MOST ACTIVE STOCKS

WEEK ENDING FEBRUARY 20

	SHARES (IN 100's)	HIGH	LOW	CLOSE
Ampex	2271	40⅞	35¼	40
Dynamics Corp Amer	1072	13¾	12½	12¾
Gen Electric	655	91	88⅛	90⅜
RCA	634	66⅞	64⅛	66½
El-Tronics	619	1⅞	1½	1⅞
Philco Corp	598	32⅛	29⅝	32¼
Collins Radio	594	57⅞	54	55⅝
Westinghouse	551	51½	48⅝	50⅛
Sperry Rand	548	24¼	22⅞	24⅛
Varian Assoc	495	49½	45¼	48¼
Avco	491	13⅞	12⅞	13⅞
Clarostat	477	14⅜	10⅝	13½
Litton Ind	467	72	65	70½
Beckman Inst	466	78¼	74⅜	74⅞
Gen Tel & Elec	458	77⅜	76	76⅛
Siegler Corp	437	35⅜	31¼	35¼
Reeves Soderft	333	10⅞	10⅛	10⅛
Lear Inc	321	18¾	17¼	18
Int'l Tel & Tel	294	34⅞	33⅛	34⅛
Texas Inst	277	178½	172	175
Univ Controls	275	15⅞	14¾	14¾
Gen Transistor	240	28⅞	24½	28¼
Raytheon	228	47⅜	45½	46⅛
Thomson Rmo Wldrg	221	54¼	51½	53⅞
Burroughs	190	33⅜	31½	31½

The above figures represent sales of electronics stocks on the New York and American Stock Exchanges. Listings are prepared exclusively for ELECTRONICS by Ira Haupt & Co., investment bankers.

DIVIDEND ANNOUNCEMENTS

	Amount per Share	Date Payable
American Bosch Arma	$.30	Apr. 15
Cons Elec Industries	.25	Apr. 1
Hoffman Electronics	.15	Mar. 31

NEW ISSUES PLANNED

	No. of Shares	Price per Share
Burnell & Co.	200,000	$3.00
International Rectifier	120,000	1.00
Pentron Electronics	250,000	3.00

Tiny, shock-proof nylon connectors—voltage breakdowns up to 12,500 volts DC!

Complete Line of Nylon Jacks, Binding Posts and Solderless Plugs. Metal-Clad Tip Jacks to MIL Specs!

This rugged group of connectors will meet severe mechanical, electrical, temperature, and humidity requirements. Tough, low-loss nylon won't chip or crack even when subjected to extreme temperature changes or abnormal mechanical stress. Connectors are designed for fast, easy mounting—available in 13 bright colors for coded applications.

MILITARY—Tip Jack complies with MS-16108 of MIL-STD-242A. Heavy nickel-plated brass jacket meets federal specification QQ-N-290. High insulation resistance of nylon body complies with MIL-P-17091. (Full specifications available on request.)

OTHER CONNECTORS—Johnson also manufactures a complete line of standard connectors in addition to the nylon line described above. For complete information, write for newest components catalog described below.

New Catalog

Write today for our newest components catalog, listing complete specifications and prices!

• Capacitors • Knobs and Dials • Sockets • Inductors • Pilot Lights • Connectors • Insulators

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OFFICIAL UNITED STATES NAVY PHOTOGRAPH

This great seaborne health center will carry a new kind of aid abroad—*with your help*. Part of the people-to-people project Hope, it will enlist 200 specialists in sharing our health skills.

Ambassador with a blackboard, the Hope specialist will help the often woefully few local medical technicians train helpers. The result: many more hands. And that means one Hope dollar is multiplied many times over.

YOUR HELP CAN COME BACK A HUNDRED TIMES OVER

One local doctor for 100,000 people. These are the odds Hope may face. Yet Hope can mean so much. The health of this child. The health of five Indonesians. *Trained* hands and only a dollar's worth of penicillin can cure them of crippling yaws.

If enough of us help, the S.S. Hope will be outbound in 1960. First port of call: Indonesia. A bold health project called Hope will be underway.

The need is crucial. Many places, too many health hazards exist. Too many people robbed of the will to live. Too few hands to help. Often, a doctor for 100,000.

Hope's approach is *practical.* Help where a nation's doctors ask help. Help them help themselves to health. By training, upgrade skills—multiply hands. Hope's doctors, dentists, nurses, and technicians will man a center complete to 300-bed mobile unit and portable TV.

You can not only make every dollar do the work of many, you can earn a priceless dividend. With health comes self-respect. People at peace with themselves are less likely to war with others.

Hope is *yours* to give. It's a people-to-people project. For one year's worth, 3½ million Americans must give a dollar. Don't wait to be asked. Mail a dollar or more now to HOPE, Box 9808, Washington 15, D.C.

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...A wide variety of designs with a wide range of capabilities providing an economical and reliable source of constant output voltage. Both PF±3% plate-filament units and standard ±½% models are available.

For special requirements, contact the Raytheon field applications engineer nearest you or write to the address below.

STYLE PF

±3% "PF" VOLTAGE REGULATING PLATE-FILAMENT TRANSFORMERS

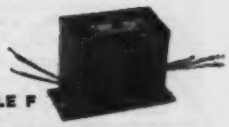
Model	Catalog No.	Input Voltages	Average DC Input Volts to Filter	Filament	Windings		Dimensions in Inches			Ship. Wt. Lbs.
				6.3 Volts	5.0 Volts	Style	H	L	W	
Plate & Filament	PF-50	100/130	275 V, DC @ 50 MA	2.5 Amps. CT	2.0 Amps.	PF	4 13/16	3 1/8	3 3/16	5
	PF-110	100/130	385 V, DC @ 110 MA	3.0 Amps. CT	2.0 Amps.	PF	4 13/16	3 1/8	3 3/16	8
	PF-250	100/130	380 V, DC @ 250 MA	#1 4.0 Amps. #2 8.0 Amps. unregulated	3.0 Amps.	PF	7	4 1/2	5	19

STYLE D

±½% STANDARD VOLTAGE REGULATORS

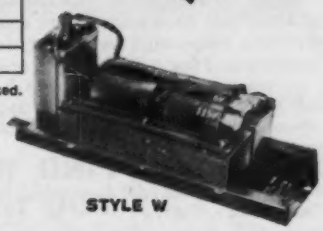
Model	Catalog No.	Output Capacity Volt-Amps.	Voltages		Style	Dimensions in Inches			Approx. Ship. Wt. in Lbs.
			Input	Output		L	W	H	
Standard[1]	VR-6110	15	95-130	115	F	6 1/4	2 3/4	3	4
	VR-6111	30	95-130	115	E	7 1/2	3 1/8	4 1/2	5
	VR-6112	60	95-130	115	E	7 1/2	3 1/8	4 3/4	6 1/2
	VR-6113	120	95-130	115	E	7 1/2	3 1/8	5 3/4	10 1/2
	VR-6114	250	95-130	115	E	12 3/8	5	7 1/4	27
	VR-6115	500	95-130	115	E	12 3/8	5	9 1/4	45
	VR-6116	1000	95-130	115	H	13 3/8	14 1/4	9 1/2	96
	VR-6117	2000	95-130	115	H	36 1/4	14 1/2	10 1/2	243
Isolated Secondary	VR-6931	60	95-130	115	E	7 1/2	3 1/8	4 3/4	8 1/2
	VR-6827	120	95-130	115	E	7 1/2	3 1/8	5 3/4	23
Harmonically Filtered (Harmonic Content Less than 3%)	VHF-6114	250	95-130	115	H	14 1/4	13 3/8	9 1/4	56
	VHF-6115	500	95-130	115	H	14 1/4	13 3/8	9 1/4	85
	VHF-6116	1000	95-130	115	H	29 1/4	14 1/2	10 1/4	220
230-Volt Output[3]	VR-6221	30	190-260	230	E	7 1/2	3 1/8	4 1/2	5
	VR-6222	60	190-260	230	E	7 1/2	3 1/8	4 3/4	6 1/2
	VR-6223	120	190-260	230	E	7 1/2	3 1/8	5 3/4	10 1/2
	VR-6224	250	190-260	230	E	12 3/8	5	7 1/4	27
	VR-6225	500	190-260	230	E	12 3/8	5	9 1/4	45
	VR-6226	1000	190-260	230	H	13 3/8	14 1/4	9 1/2	96
	VR-6227	2000	190-260	230	H	36 1/4	14 1/2	10 1/4	243
Filament	VR-6101	30	95-130	6.0/7.5	E	7 1/2	3 1/8	4 1/2	5
	VR-61F0	15	95-130	6.3	F	5 3/4	2 1/4	4 3/4	6 1/2
	VR-61D0[2]	15	100-130	6.3	D	3 3/8	2 1/4	4 1/16	5 1/2
	VR-6710	25	95-130	6.0	W	7 1/8	3 1/8	3 3/8	4

STYLE E



STYLE F

STYLE H



STYLE W

1. 50-Cycle Models also available with these specifications. 2. Regulation ± 1%. 3. 230-Volt Models not generally stocked.

Specials can be designed to meet a variety of electrical and mechanical specifications. Write Raytheon Company, Applications Engineering Department, Manchester, New Hampshire stating your requirements.

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What *useable* discoveries are being made on the frontiers of electronic knowledge? Here are a few selected at random: directive long-range sonar transducer . . . high-speed ferrite memory and logic element . . . space-probe telemetry system . . . master preamplifier for X-band radar. You can never tell when one is going *your* way. This is just ONE of the reasons why you should subscribe to **electronics** (or renew your subscription). Fill in box on Reader Service Card. Easy to use. Postage free.

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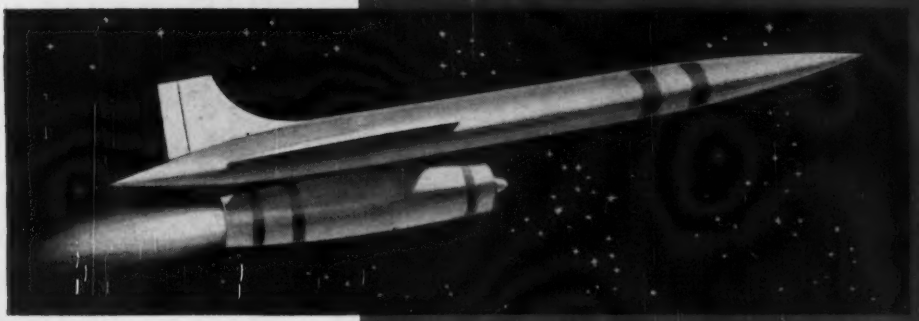

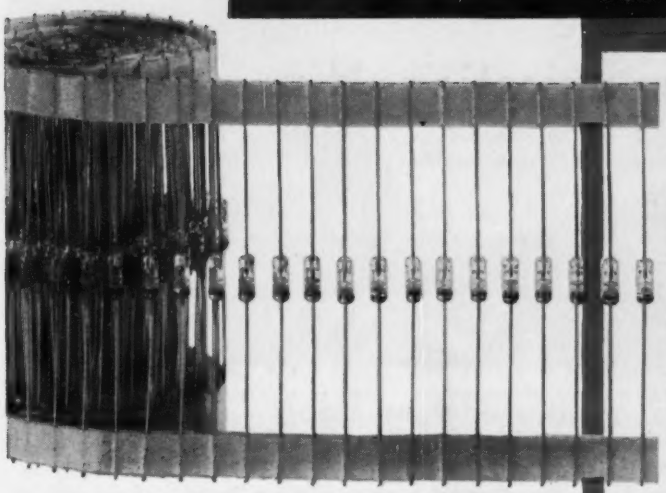

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- Temperature cycling, −65° to 85°C
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- Automatic, both forward and reverse
- Pulse recovery time, JAN 256 circuit
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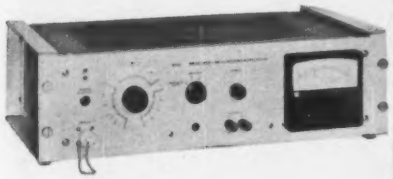
new, low-cost
micro-microammeter



Model 414 offers high performance over 17 ranges for just $280.00!

● The Keithley 414 Micro-micro-ammeter is today's lowest-cost instrument for low current measurements in production tests, monitoring installations and experiments in the range of 10^{-2} to 10^{-11} ampere. The 414 can be used as the amplifier element in systems, such as reactor controls, thickness gauges, ionization gauge control in high-vacuum equipment. Contact meter models are available for go, no-go production tests, alarm and control systems.

SPECIFICATIONS

Ranges: 17 ranges in 1x and 3x steps, from 10 ma to 0.1 mμa f.s.

Accuracy: Within ±3% of f.s. to 10 mμa; ±4% on lower ranges.

Input Voltage Drop: Below 5 mv all ranges with full-scale signals.

Response Time: Below 0.5 sec. all ranges, for any input capacitance to 5000 μμf.

Zero Drift: Below 2% of f.s. per day.

Recorder Output: 5 volts with a 1 ma capability.

Price: Model 414 . . . . . $280.00

For full details, write:

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INSTRUMENTS

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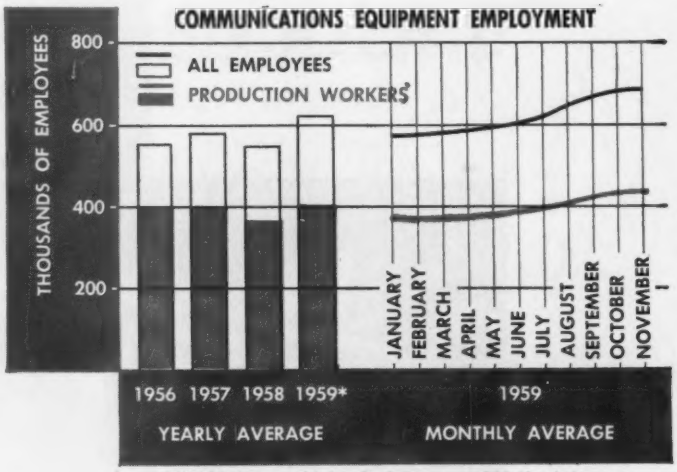
CLEVELAND 6, OHIO



SOURCE: Bureau of Labor Statistics *11-Month Average

Communications Hiring Up 13%

EMPLOYMENT in the communications equipment industry is setting new records.

Total employees during the first 11 months of 1959 averaged 623,000, an increase of nearly 13 percent over 1958 and 7.5 percent higher than 1957, the previous peak year. Indications are strong that the early months of this year will see the total number of employees top the 700,000 mark.

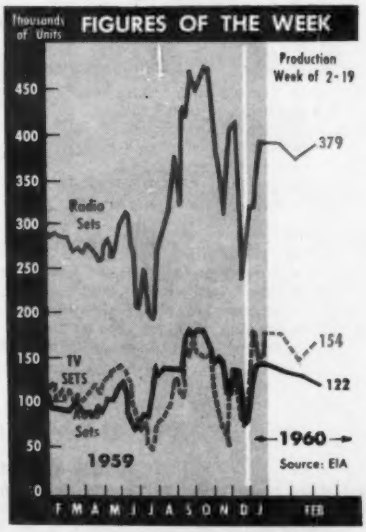
Guide to Trends

In the first 11 months of 1959 the number of production workers averaged 398,900, an increase of 12.2 percent over 1958. But following the national trend, production workers in the communications industry have declined as a percentage of all employees. Between 1956 and 1959 the production percentage of the total dropped from 70.3 percent to 64 percent.

The chart shows yearly and monthly employment averages for all employees and production workers engaged in the manufacture of electrical communications equipment and related products. Though not an exact measure of employment in the electronics industry, it does serve as a good guide to general trends.

Total number of employees in 1956 averaged 557,800, while production workers averaged 392,000. In 1957 the total average went up 4 percent, with only a fractional increase in production workers. Recession year 1958 saw a 5-percent drop in all employees, and a 10-percent drop in production workers. But the picture began to improve steadily in the second half of 1958.

• **David Sarnoff,** RCA chairman, looks for a hike of nearly 80 percent in electronics industry sales volume by 1965. He predicts electronics sales will rise from $14 billion in 1959 to $25 billion in 1965. He includes broadcasting, service, installation, distribution revenue, factory sales in totals.



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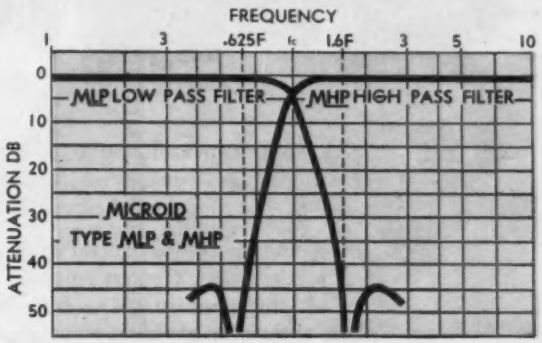
This system adds greatly to your credit when applied to the development of communications, telemetering, control and other devices. Under terms of membership, a wide range of toroids, filters and related networks are available. These include a complete line of inductors, low pass, high pass and band pass filters employing the new micro-miniature *MICROID* ® coils so valuable in transistorized circuitry. Type *MLP* and *MHP MICROIDS* are micro-miniature counterparts of the popular Burnell types TCL and TCH low pass and high pass filters. The band pass filter results when cascading a TCL with a TCH filter.

Sizes of MLP and MHP MICROIDS

400 cps to 1.9 kcs – $1\frac{1}{16}$ x $1\frac{15}{16}$ x ½
2 kcs to 4.9 kcs – $1\frac{1}{16}$ x $1\frac{5}{8}$ x ½
5 kcs and up – $\frac{5}{8}$ x $1\frac{5}{16}$ x ½

Weight of all MLP and MHP Microids–approx. .3 ozs. each

Send now for your free membership card in the Space Shrinkers Club. And if you don't already have our Catalogue #104 describing Burnell's full line of toroids, filters, and related networks, please ask for it.



Note: First informal meeting of Club members will be held in Burnell Booths 2909-2910 during the IRE Show, New York Coliseum, March 21-24. See you there.

Burnell & Co., Inc.
PIONEERS IN microminiaturization OF TOROIDS, FILTERS AND RELATED NETWORKS

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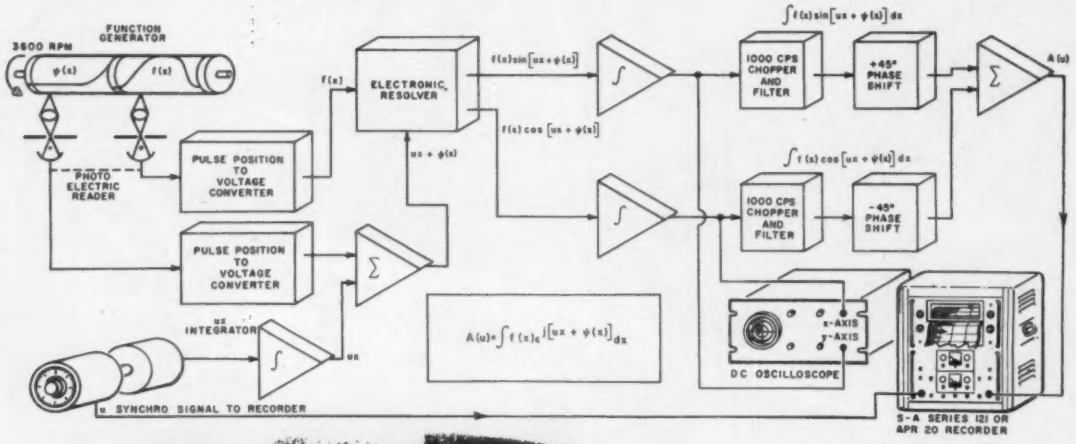
MURRAY 2-2841
TELETYPE: PASACAL 7578

Simplified block diagram of Model CF-1. Amplitude and phase input functions are plotted on graph paper for presentation. Integration is observed on a dc oscilloscope. Absolute magnitude is recorded on any S-A Series 121 or APR 20 Antenna Pattern Recorder with a logarithmic response.

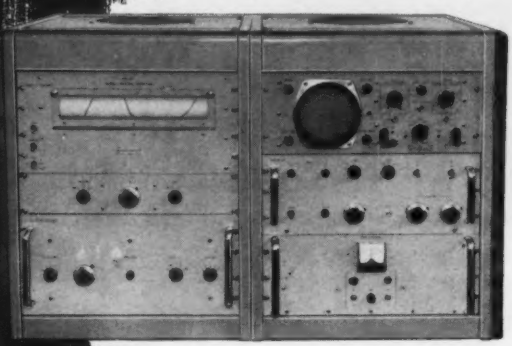


To solve

$$A(u)=\int_{-1}^{1} f(x)\, \epsilon\, j[ux+\psi(x)]\, dx$$

investigate the new

S-A INTEGRAL FOURIER COMPUTER



Model CF-1

A sophisticated solution to the vexing problem of solving bounded Fourier integrals quickly and accurately, Scientific-Atlanta designed the Model CF-1 especially for the antenna design engineer.

The computer has broad general application including determination of the far fields of aperture antennas from the distribution of the field in the aperture, the far fields of arrays from the magnitude and phase of the currents in the elements, the frequency spectra of voltage pulses, and other physical problems involving Fourier transforms and their inverse transforms over finite limits.

PRICES

Model CF-1 Fourier Integral Computer . . . $9,000

Model APR 22 Antenna Pattern Recorder (logarithmic response) . . . $4,300

See the CF-1 and other new S-A Microwave Instrumentation at IRE Booth 3909

Consult your nearby S-A engineering representative for more information. Or you may write directly to the factory for complete specifications. Address Dept. 18-3.

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Lowest Cost Fastener You can buy

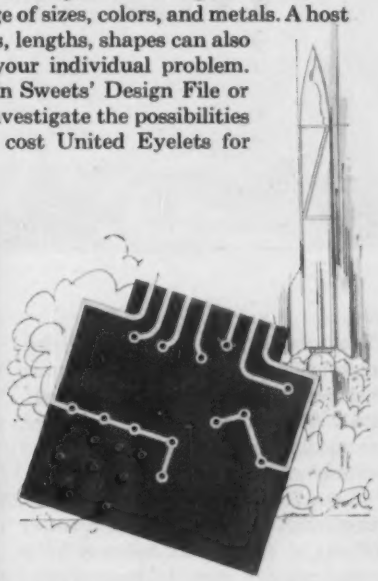
Low initial cost per thousand, low installed cost with highly engineered high speed United Eyeleting machines, and you have an unbeatable combination you can put to work saving money. They will join dissimilar materials, can be clinched tightly to fasten, or lightly to function as a pivot.

They can be used as a bearing, or as a terminal. With ceramics, plastics, and glass special machine device helps minimize fracturing. You can get them from stock in a wide range of sizes, colors, and metals. A host of special diameters, lengths, shapes can also be made to solve your individual problem.

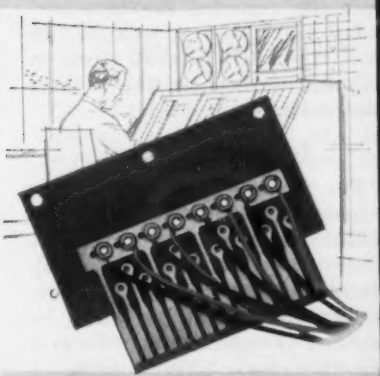
See our catalog in Sweets' Design File or write us today to investigate the possibilities of utilizing lowest cost United Eyelets for your product.

High speed fastening of 2 eyelets simultaneously cuts costs on automotive ignition breaker point assembly.

Eyelet does double duty as fastener for wind shield, bearing for spark wheel. Does both jobs well for only a fraction of a cent.

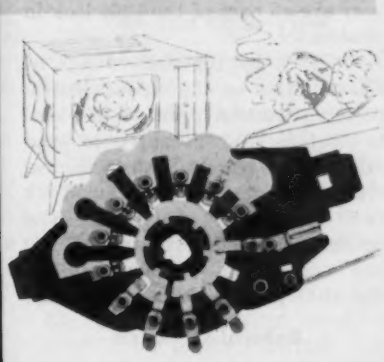


For high altitude or on the ground, funnel flange eyelets provide positive means for making reliable thru-connections on two-sided printed wiring boards.



JUST plug it in — United Standardized eyelets hold wires by compression on multi-contact computer part. Tight hold eliminates soldering time and bulk.

Before you say "hello", eyelets are working for you on our most popular method of communication. Try them on a new application — perhaps they'll prove as indispensable as your telephone.



You can avoid the inevitable commercial with the T.V. Selector Switch and still enjoy the silent utility and performance of eyelets on the switch itself.

Free Eyelet Slide Selector helps determine which eyelet you need with given grip and hole diameter.

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What Exhibitors Are Saying

THE YEAR of the Conservative Approach is what some observers are beginning to call this year's outlook for the electronics industry, as exhibitors prepare for the rigors of the annual New York IRE show.

Less frenetic recruiting activity, new emphasis on selling, greater efforts to develop nonmilitary business, concern over increasing foreign competition, and general business caution stemming partly from the performance of stocks early this year are all part of the 1960 look in electronics.

A check by regional editors of ELECTRONICS on the business prospects of manufacturers from coast-to-coast as they prepared to send sales, management and technical representatives to the New York IRE show and convention—now called the IRE International Show and Convention—reveals that the executive pulse is quick but steady.

General Optimism

The factors of conservatism and caution are balanced by a general optimism that business will be better this year than last year, and substantially so in many cases.

For example, a West Coast semiconductor manufacturer feels that the exhibits and papers this year will point up the rapid growth of the semiconductor field and the importance of new products such as the tunnel diode entering the stage of large-scale production.

He expects solid-state electronics to highlight the show. The executive, who predicts a 50 percent increase in his own company's semiconductor sales this year, will keep his eyes open for new fabrication techniques and production men as several projects at his firm emerge from the R&D stages.

Apprehension Reflected

An executive of an electronics company with major space contracts says industry's caution and apprehension will be reflected at the IRE show.

"We feel that recruiting, for example, will be at a much less frenetic pace than in years past. Many companies are digging in and making do with their present staffs.

"We feel that the deeper-than-anticipated market dip during the first two months of 1960 has tended to act as somewhat of a damper on what might have been unbridled enthusiasm for this so-called most prosperous year yet.

"We want to sample sentiment regarding the ever-increasing competition from foreign companies. We also want to examine some of the products built abroad and marketed through U. S. firms."

From the marketing manager of a New England electronics company comes this comment:

"There's going to be a shortage of salesmen this year. There will be plenty of business around, but also plenty of competition. The electronics industry will have to concentrate on selling—something which it has never really learned to do."

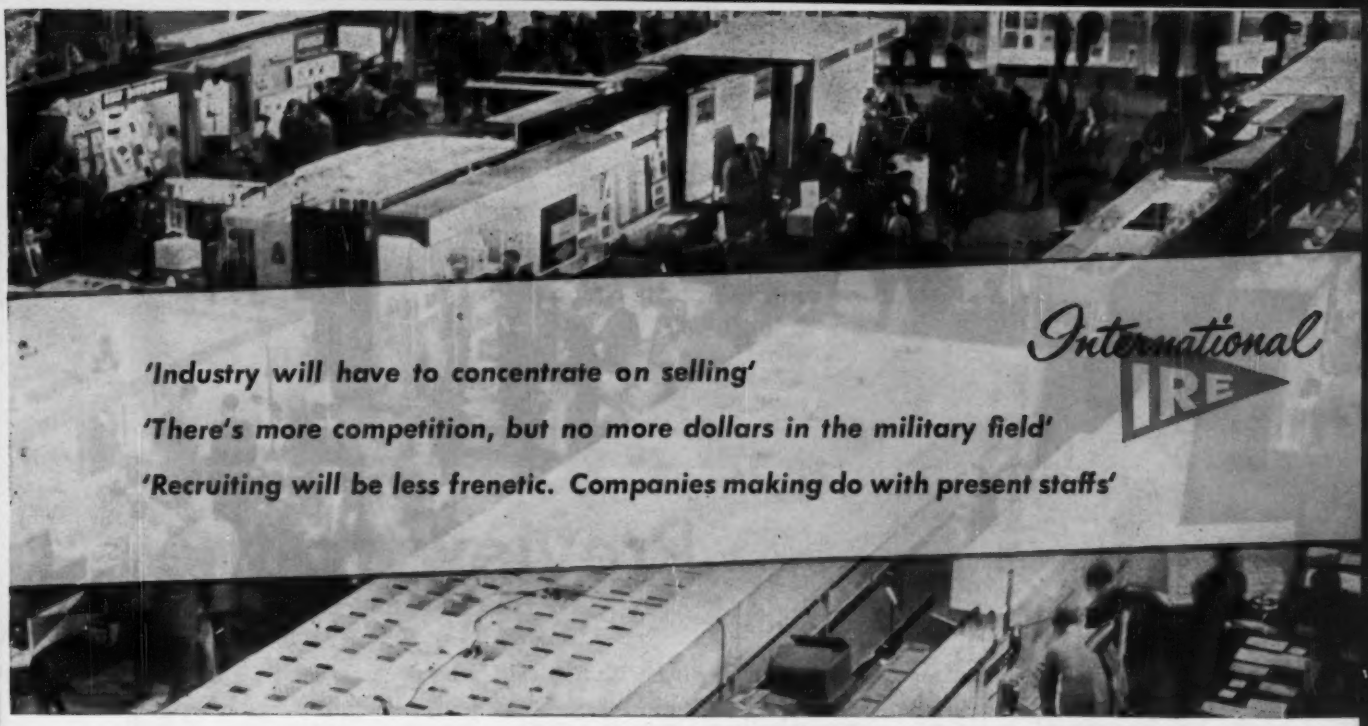
An aviation-electronics company official expects to see hardware in such fields as aerospace and space medicine—fields which he says were generally regarded as "blue sky" at last year's show. "Certainly," he says, "there will be more stress on technical sessions relating to space electronics."

Technical Emphasis

The executive, whose company actively recruited during previous IRE shows, expressed the view that while the show attendance may reach a new record, some of the recruiters of previous years will be replaced by technical men. He said that this year a larger number of persons would attend the New York convention and show for the purpose of getting the latest word on technical developments.

An instrumentmaker is sending a large technical contingent to New York this year with a threefold purpose:

"To see what innovations our competition has come up with; to


'Industry will have to concentrate on selling'
'There's more competition, but no more dollars in the military field'
'Recruiting will be less frenetic. Companies making do with present staffs'
International
IRE

learn what's new in the states of the arts that affect our design and production groups; and to make contacts for future sales follow-ups."

Some companies see in the show a valuable opportunity to help change the company image.

A microwave components firm, for example, will spotlight computer diodes at the show. "Nobody associated us with this field up to now," says an executive. "We hope this year's show will introduce that association."

Military Business Outlook

An official of a fast-growing West Coast firm believes that stock market-induced pessimism will have run its course by IRE show time, but offers some sobering opinions on military business:

"I feel that fear of a possible 10 percent cutback in the military budget may become evident," he says. "There are many fringe area military subcontractors to whom such a cutback would mean more like a 100 percent cutback.

"These people are frantically trying to find some commercial or industrial applications of their current military capabilities to guard against such a possibility. And, because of increased competition for the fewer military contracts available, you'll see proposal writers at the show cramming all the useable knowledge they can soak up."

There are other factors in the military market picture that make this year's IRE convention and show an especially important market-place for ideas, information and industrial business for companies seeking to balance past dependence on military contracts.

A Midwest military products manufacturer expressed the dilemma of many firms heavily engaged in military contract work with his comments on military procurement trends. He notes a tendency towards more advertised procurement as a result of Congressional pressure, explains:

"This is forcing us and other manufacturers into higher research and development effort, some not allowable as expenses on cost-plus-fixed-fee contracts. There's more increased competition, but no more dollars in the military field."

Low Quantity Items

The same executive sees a further pinch resulting from decreased military spending on large-quantity items and more buying of low-quantity, high-cost items.

A New England components manufacturer chimes in: "A few more cancellations like the B-70 and an awful lot of people are going to get badly hurt."

Swing from military to commercial sales in the components field is emphasized by a Midwest executive: "In volume, no, but in dollars, yes, our military production is still pretty healthy. Packaged circuit units, for use in all sorts of products from hearing aids to guided missiles, are a big sales factor. We're working constantly on production of devices which have a density of five million per cubic foot. These units are seeing increasing use."

An East Coast View

The executive v-p of a large electronics company in the East summed up his feelings about business at IRE show time this way:

"Beating the breast in advance is not a very bright thing to do, but we can say we are going to have a better year than last year." Here's why:

He expects his company to benefit from the growing electronic slice of the military budget, if the budget continues at present anticipated levels. His company is investing heavily in new components —"and components stimulate a lot of equipment and systems." In addition, his firm is working hard on development of industrial process control systems, an expansion avenue which many electronics companies are now taking.

- Advances in aerospace subsystems
- Transistorized nuclear instrumentation
- The human as originator of signals and schemes
- New contributions to circuit theory

International IRE

Previewing the

NEW YORK—Progress in electronics over the past three and a half decades will be reflected in the program slated for presentation here during this year's 35th annual convention of the Institute of Radio Engineers. For the first time, the convention is officially called 'International.'

In the four-day period starting a week from Monday, 258 papers will be presented in 54 technical sessions. There will be 10 more papers this year than there were in 1959. Thirty-three of the sessions will be held at the Waldorf-Astoria, remainder at the Coliseum.

Signs of Change

Back in 1925, founders of the IRE would have doubtlessly looked askance at some topics today's convention-goers will take as a matter of course. One example is a session titled "Electronics—Out of This World", which will feature papers on Intergalactic Data, Control of Weather and other similar topics.

Another evidence of change from electronics topics of past years will be the session on "Industrial Electronic Instrumentation". It will include papers on automation for supermarkets, the role of electronics in agriculture and others.

Broadcasting, which has waxed in some years and waned in others, appears to be on the rise again as a subject of large interest. Spots throughout the four-day period will be devoted to this topic.

Heavy attendance is expected at the seminar dealing with the recently-concluded International Telecommunications Union in Geneva, Switzerland. Speakers at this seminar will be men who attended the conference. The session will be held on the morning of Mar. 23 in the Grand Ballroom of the Waldorf-Astoria.

Virtually every technical aspect of broadcasting will be discussed to some degree at the convention. Topics will range from antenna design to film room mechanization at a tv station.

Computers

The increased use of computers in so many applications will also be reflected in the program fare this year. One session of special interest will be the 33rd, slated for the afternoon of Mar. 23.

This meeting will deal with the ways in which circuit theorists and computermen can help each other. Session 40, to be held Mar. 24, will deal with adaptive networks. It will bring to light new information about the learning processes now deemed possible for computers and the self-organizing possibilities and actualities of today's computer design.

Medical Electronics

This year's convention will emphasize the human problems rather than the technical problems that must be overcome in the area of medical electronics. Session 21, for example, will deal with the human body as originator of signals and schemes. Speakers will include medical men as well as engineers. Session 14, "Varied Views of Medical Electronics" will highlight the training of medical engineers, biological microwave hazards and other aspects of man's physical place in today's medical engineering.

Space Sessions

In keeping with the importance of electronics in space technology, four sessions will be devoted to this area. One will deal with advances in aerospace subsystems and cover such topics as range ambiguity resolution in high PRF radar, the nature of Astro Doppler velocity measurements and related topics.

Space telemetry will be the subject of Session 28 to be held on the morning of March 23. Papers presented will deal with a data processing facility, detection levels and error rates in PCM telemetry systems and other aspects of space telemetry. A session on satellite communications will treat such subjects as radio relaying by reflection from the sun, ground station design for satellite communication systems, detail design of an operational missile voice frequency system and other topics germane to this subject.

Blending In

One sign of the meshing of methods and information that is gradually coming about between electronics and other sciences is evident in Session 25. Titled "Detect-

Program . . .

tion Theory and Applications to Physics," this session will present such papers as: Estimating of Doppler Shifts in Noise Spectra, Optimum Coincidence Procedures for Detecting Weak Signals in Noise, An Aspect of Information Theory in Optics and other papers having to do with the physics of noise as applied to electronics.

Looking to the future, Session 27, "Electronic Component Parts", will lead off with a paper titled "An Evolution Is Coming", by R. Dewitt of the Pentagon. Following will be a talk by another military speaker, W. S. Heavner, of Wright-Patterson AFB, "Tomorrow's Technology—Functional Electronic Blocks". On hand from Ft. Monmouth, N. J., will be L. D. Rouge and D. R. Winkler of the Army Signal Corps, who will speak on Electronic Progress Circa 1960.

In keeping with the sentiments of one wag—who said the future of electronics will be smaller and better than ever before—the two final papers of Session 27 will be "The Thermionic Integrated Micromodule" and "Microcircuitry—A Practical Technology for Reliable Microminiaturization."

Heavy Emphasis

The growing area of ultrasonics is slated for coverage by two full sessions, the 34th on Mar. 23 and the 42nd the following afternoon. In all, 14 papers will be presented by representatives of 12 companies, plus one talk by D. L. Schilling and A. N. Silver of Columbia University on Ultrasonic Delay Line Analysis.

The first of two sessions on ultrasonics will deal heavily with theory, while the second will stress applications. Papers to be presented in Session 34 deal with Eigen Coupling Factors and Principal Components, The Thermodynamic Invariants of Piezoelectricity, Piezomagnetic Ceramic Transducers, An Ultrasonic Power Source Utilizing a Solid-State Switching Device, and related subjects.

Several Levels

Session 42 will present the following papers: Measurement of River Flow by the Use of Underwater Sound, Ultrasonic Flowmeters, Optical Studies of Delay Line Transducers, Ultrasonic Delay Line Analysis, and others—including a talk on New Techniques in Ultrasonic Delay Lines.

Communications will come in for a full share of attention at several levels.

Session 4, Radio Frequency Interference, will be a six-paper session dealing with methods of detecting, analyzing and combatting r-f interference. Session 30, programmed for the morning of Mar. 23, is called "Communication Systems Design." Five papers will be presented, the first being "Configuration and Performance Criteria for Fully Optimized Troposcatter Systems". Next will follow "Multifold Diversity Combining Techniques, Simple Methods for Designing Troposcatter Circuits and Optimized SSB Transmitter Loading by Multichannel Frequency Division Data." The last paper in the group is titled "Quicksilver—A Long-Range General Purpose Communications System".

In a more specialized vein, Session 32 will deal with microwave filters. Talks given will center about such topics as band-pass filter design, quarter-wave transformers, magnetically tunable filters and related topics.

Akin to Session 30 will be Session 37, slated for the afternoon of March 23. The main topic will be Communication Systems Techniques. The session will include two speakers from Japan and one from Canada. Subjects covered will be analysis of a phase modulation communications system, frequency shift systems, improvements in multiplex voice frequency carrier systems and other matters dealing with communications systems.

Meet the Editors

"A pleasure to see you."

ELECTRONICS' editors are looking forward to saying this hundreds of times during the International IRE Show.

Every minute of the show, one or more editors will be at our booth. In doing our job—editing the only engineering weekly in the field—meeting electronics industry people has top priority.

Our booth number is 4314-4316. Our interest is you.

Do drop by

FOTOCERAM circuit board blanks are made using the micro-accuracy of photography. All holes and shapes are produced by simple exposure to light, heat, and an etching operation.

No bending, bowing or delaminating with a FOTOCERAM printed circuit board

Made of one solid piece of Fotoceram material, these printed circuit boards can't delaminate, because there are no laminations—the problem of bending, twisting and warping are eliminated, even under high ambient temperatures.

Dimensional stability is so great you'll want to use them for environmental stress tests.

Through-hole plating presents no problems, either. We plate through the hole uniformly with the same conductor material. Thermal conductivity, as well as electrical conductivity, is exceptionally good. You can even make a solder bridge over a hole with no gap and without a wire.

Resolderability is excellent—we've removed and resoldered components over fifty times on a Fotoceram board without damage to runs or holes.

In addition, Fotoceram boards provide good adhesion, exceptional pull strength, zero water absorption. They are non-flammable, never blister.

We are now equipped to produce Fotoceram printed circuit boards in quantity on a mass production basis and at a practical cost.

For more information, write for our data sheet to **Corning Glass Works**, 539 High Street, Bradford, Pa. Or contact our sales offices in New York, Chicago or Los Angeles.

CORNING ELECTRONIC COMPONENTS

NEW . . . FROM INDUSTRY'S BROADEST RECTIFIER LINE

SILICON CARBIDE RECTIFIERS

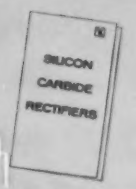
FEATURES

- IMPROVED RELIABILITY AT ELEVATED TEMPERATURES
- HIGHER TEMPERATURE PERFORMANCE TO 500°C
- EXCELLENT RADIATION RESISTANCE

Silicon carbide rectifiers are now available for production requirements. Their inherent higher temperature capabilities (to 500°C) provide greater reliability in existing circuitry subject to high ambient temperatures. Resistance to radiation is up to 100 times greater than previously available in any semiconductor rectifiers.

	SPECIFICATIONS @ 500°C			RATINGS @ 500°C	
Type	Peak Inverse Voltage (volts)	Maximum Inverse Current I_R (μa)	Maximum Forward Voltage @ Specified Current (volts @ mA)	Maximum Average Forward Current I_O (mA)	Maximum Peak Inverse Voltage (volts)
TCS10	100	500	6 @ 100	100	100
TCS5	50	500	4 @ 100	100	50

	SPECIFICATIONS @ 25°C		
Type	Peak Inverse Voltage (volts)	Maximum Inverse Current I_R (μa)	Maximum Forward Voltage @ Specified Current (volts @ mA)
TCS10	100	10	12 @ 100
TCS5	50	10	8 @ 100



Write for Bulletin PB-70

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FROM INDUSTRY'S BROADEST SILICON LINE...

DIFFUSED MESA

2N696
2N697

The diffused mesa 2N696 and 2N697 are now added to Transitron's broad line of silicon transistors. Combining linear beta characteristics with mechanical and thermal ruggedness these transistors offer increased reliability for higher frequency medium power circuit applications.

For complete data, write for Bulletins TE-1355B-3, TE-1355B-4.

ABSOLUTE MAXIMUM RATINGS			
Collector to Emitter Voltage	V_{CE}	40	Volts
Collector to Base Voltage	V_{CB}	60	Volts
Emitter to Base Voltage	V_{EB}	5	Volts
Total Power Dissipation: at 100°C Case Temperature		.1	Watt
at 25°C Amb. Temperature		0.6	Watts
Storage and Operating Temperature Range		−65 to +200	°C

SPECIFICATIONS AND TYPICAL CHARACTERISTICS AT 25°C					
		Min.	Typical	Max.	Test Conditions
D.C. Current Gain 1 h_{FE}	2N696	20	35	60	I_C = 150ma, V_{CE} = 10V
	2N697	40		120	I_C = 150ma, V_{CE} = 10V
D.C. Input Voltage 1 V_{BE}		—		1.3 V	I_C = 150ma, I_B = 15ma
D.C. Collector Saturation Voltage 1 V_{CE}		—		1.5 V	
Collector Cutoff Current I_{CO}		—		1.0 μa	V_{CB} = 30V
Collector Cutoff Current I_{CO}		—		100 μa	V_{CB} = 30V, 150°C
Output Capacitance C_{ob}		—		35 μμf	V_{CB} = 10V, F = 1mc
High Frequency Current Gain h_{fe}		2.5			V_{CB} = 10V, I_C = 50ma, F = 20mc

1Measured on Pulse Basis: t pulse = 8 milli-sec; duty cycle = 1 per cent.

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FROM **Transitron**...INDUSTRY'S BROADEST LINE OF

CONTROLLED RECTIFIERS & SWITCHES

SILICON CONTROLLED RECTIFIERS are now available in both the ⅛" hex and 1⅛" hex base packages. Replacing thyratrons and magnetic amplifiers in many applications these rugged devices offer greater reliability and increased efficiency. Some typical applications are:

- industrial control
- lighting control
- solid state inverters
- overvoltage protection
- short circuit protection

Write for Bulletin TE-1356

TYPE	PIV	Max. average amps Forward current at 25°C case	at 100°C case	Hex size of Package
TCR 520	50	20	10	1⅛
TCR 1020	100	20	10	1⅛
TCR 1520	150	20	10	1⅛
TCR 2020	200	20	10	1⅛
TCR 2520	250	20	10	1⅛
TCR 3020	300	20	10	1⅛
TCR 3520	350	20	10	1⅛
TCR 4020	400	20	10	1⅛
TCR 510	50	10	5	1⅛
TCR 1010	100	10	5	1⅛
TCR 1510	150	10	5	1⅛
TCR 2010	200	10	5	1⅛
TCR 2510	250	10	5	1⅛
TCR 3010	300	10	5	1⅛
TCR 3510	350	10	5	1⅛
TCR 4010	400	10	5	1⅛
TCR 503	50	5	2	⅛
TCR 1003	100	5	2	⅛
TCR 1503	150	5	2	⅛
TCR 2003	200	5	2	⅛
TCR 2503	250	5	2	⅛
TCR 3003	300	5	2	⅛
TCR 3503	350	5	2	⅛
TCR 4003	400	5	2	⅛

THE TRANSWITCH is a new bi-stable silicon computer element that can be turned *OFF* with a gate current. Extremely uniform electrical characteristics over a wide current range (2-50 ma) permit the device to fulfill low level logic and medium power needs. The device is designed for:

- miniaturized memory circuit
- ring counters
- shift registers
- controlled rectifier driver
- flip-flop equivalent

Write for Bulletin TE-1357A

SPECIFICATIONS AND TYPICAL CHARACTERISTICS (at 25°C Unless Otherwise Stated)

		Typical	Maximum		Test Conditions
Saturation Voltage	V_s	1.0	1.5	Volts	I_C = 50 mA
Forward Leakage Current	I_F	0.1	10	μA	AT RATED VOLTAGE
Reverse Leakage Current	I_R	0.1	10	μA	AT RATED VOLTAGE
Forward Leakage Current	I_F	20	50	μA	at 125°C
Gate Voltage to Switch "ON"	V_G on	0.7	1.0	Volts	R_L = 1 K
Gate Current to Switch "ON"	I_G on	0.1	1.0	mA	R_L = 1 K
Gate Voltage to Switch "OFF"	V_G off	1.2	4.0	Volts	I_C = 50 mA
Gate Current to Switch "OFF"	I_G off	7.0	10	mA	I_C = 50 mA
Holding Current	I_H	2.0	5.0	mA	R_L = 1 K

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MICRO-MINIATURIZATION POSSIBLE NOW!

YES — FASTEST DIFFUSED SILICON MICRO-DIODES AVAILABLE. They combine advanced diffusion techniques with extremely small size, to provide milli-micro-second switching speeds, excellent static, forward and inverse characteristics.

YES — ONLY SERIES OF HIGH QUALITY MICRO-REGULATORS. Series of 8 diffused-silicon micro-regulators provides stable voltage regulation and reference sources previously found only in considerably larger devices. Excellent dynamic resistance characteristics.

YES — BASIC FAMILY OF MULTI-PURPOSE MICRO-DIODES. Series of 3 high quality diffused-silicon micro-diodes provides voltage ratings up to 200 volts, current rating up to 50 milliamperes. May be considered for switching applications. Exceptional static, forward and inverse characteristics.

YES — EVEN A MICRO-STABISTOR.
This diffused-silicon stabistor is the micro-counterpart of Transitron's universally-known SG-2.

All of these new micro-diodes are COMPLETELY COMPATIBLE with present circuitry . . . provide the same excellent performance as larger Transitron diodes in 1/10th the space! Here is your chance to micro-miniaturize circuits TODAY!

VERY FAST SWITCHING MICRO-DIODE			
TYPE	PIV	Ef @ 5 MA	RECOVERY TIME
TMD-50	50V	0.75V	4 mμsec

FAST SWITCHING MICRO-DIODE			
TYPE	PIV	Ef @ 20 MA	RECOVERY TIME
TMD-24	50V	0.85V	0.3 μsec
TMD-25	100V	0.85V	0.3 μsec
TMD-27	200V	0.85V	0.3 μsec

SILICON MICRO-REGULATOR		
TYPE	VOLTAGE @ 5 MA	POWER RATING @ 25°C
TMD-01	5.1V	100 MW
TMD-03	6.2V	100 MW
TMD-07	9.1V	100 MW

HIGH CONDUCTANCE MICRO-DIODE			
TYPE	PIV	Ef @ 100 MA	POWER RATING @ 25°C
TMD-41	50V	1.0V	100 MW
TMD-42	100V	1.0V	100 MW
TMD-45	200V	1.0V	100 MW

SILICON MICRO-STABISTOR		
TYPE	Ef @ 1 MA	DYNAMIC RESISTANCE
TMD-40	0.55V	60 OHMS

For further information, write for Bulletins:

PB-71A (High Conductance), PB-71B (Fast Switching), PB-71C (Very Fast Switching), PB-71D (Stabistor), PB-71E (Regulators); AN 1358A Application Notes.

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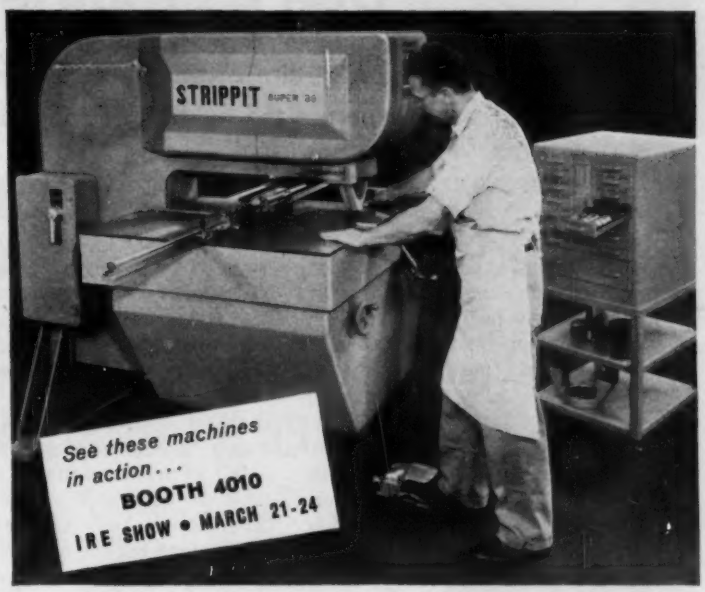
THE STRIPPIT SYSTEM

...for high-profit, low cost production of sheet metal parts and printed circuit boards

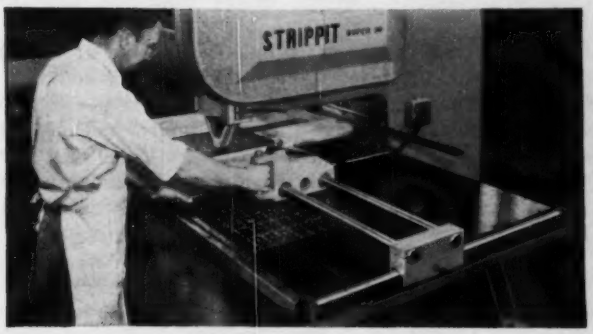
PUNCHING • NOTCHING • NIBBLING • DRILLING

Model 15A Strippit Fabricator with the new Electro-Hydramatic Head and a 15" throat depth.

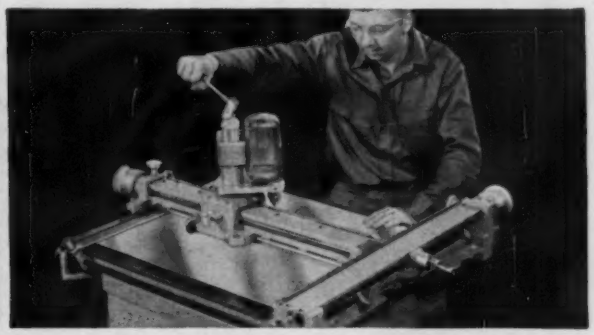


The new Strippit Super 30 Fabricator also has an Electro-Hydramatic Head, a 30" throat depth and many other exclusive features.

STRIPPIT FABRICATORS FOR SHORT OR PILOT RUNS — are amazingly versatile machines which punch any sheet material up to ¼" mild steel. They produce clean, burr-free work with minimum time-out between jobs. Standard interchangeable tools or "specials" are ready for instant use in the universal tool holder. Multiple-stop gauging ensures exact work positioning in seconds. Close-centered hole clusters, all types of notches, square or contour nibbled cutouts are easy, profitable operations on a Strippit Fabricator.



STRIPPIT DUPLICATOR FOR PRODUCTION RUNS — equips the Fabricator for medium-run production of precision sheet metal parts or cold-punched printed circuit boards — without custom dies. Functioning like a pantograph, it reproduces any hole pattern from a drilled or punched template. Two other accessories — the Microbar Assembly and the Dupl-O-Scope — are used to make accurately punched templates or "one-of-a-kind" workpieces.



STRIPPIT FLEX-O-DRILL DRILLS, REAMS, SCRIBES AND CENTER PUNCHES — with tool room accuracy. It eliminates the need for base line drawings and vernier height gauge layouts. The Strippit Flex-O-Drill can handle stock up to 24" width, any length and any material up to ¼" mild steel. With this machine, layout and template making time can be cut 50% or more. It is also a proved money-saver on pilot runs or low unit production.

WRITE TODAY — We will show you how you can effect major savings with the Strippit System of fabrication.

UNIT OF HOUDAILLE INDUSTRIES, INC.

WALES **STRIPPIT** INC.

225 Buell Road • Akron, New York

In Canada: Strippit Tool & Machine Company, Brampton, Ontario

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CIRCLE 39 ON READER SERVICE CARD 39

International IRE

'Don't Promise the Moon . . .'

Plan to hire engineers during this month's IRE show? Here, from an expert in the field, are some timely do's and don'ts

By Arnold R. Deutsch, President, Deutsch and Shea, Inc., New York, N. Y.

THERE ARE NO SHORT CUTS or easy ways in hiring engineers and scientists for your company.

The process is basically a problem in human relations and thus complex. But there are pointers and guideposts to bear in mind that will help you do a more effective job.

The impression your company makes upon the engineer is the deciding factor in whether or not he accepts your offer. These are some of the well-proven do's and don'ts of hiring professional men that too many firms still neglect, with resulting high recruiting costs.

DO learn about the attitudes and psychological makeup of engineers and scientists. Our studies show that engineers as a group have certain well-defined characteristics in common but differ from each other according to the functions they perform. A research engineer, for example, has a different set of job expectations than a design engineer. Understanding the professional man is important.

DO get continuing "feedback" from your successes and failures. Find out why recently hired engineers and scientists accepted positions with your company and determine, also, why others turned down your offers. This will give you a running picture of the strengths and weaknesses of your firm and your recruiting ways.

DO treat engineers and scientists as professional people. Provide separate interviewing facilities, separate employment forms and other material. Technical and scientific men are particularly status-conscious and look for signs that the company recognizes and treats them as professionals.

DO be prepared to talk factually to these men and to provide details. By the very nature of their professions they are fact-oriented, and experience has made them skeptical of generalizations about jobs. Use facts and figures on your sales increases, additions to your staff, contracts you now have. Document your intangible advantages, such as creative climate, with examples, case histories, specific policies and practices.

DO be prepared to talk technically. Many engineers complain of interviewers who cannot answer specific questions about technical aspects of the positions offered. Thorough familiarity with the company's projects, operations, and specific openings is essential.

DO take the professional man's wife and family into consideration. According to one of our studies on engineers, more than 80 percent indicate that the wife plays an important role in the final job decision. Provide material for the wife on your company's location and its family advantages.

DO use a personal approach in all of your contacts with engineers and scientists. On the average, these are men of considerable intelligence and professional stature. They resent rubber-stamp treatment that does not recognize them as individuals. This applies to personal and written contacts.

Finally, and especially important, *do* realize that the most important motivating factor in job selection to the technical man is the nature of the work that you offer him.

There are also practices to avoid, things that you may be doing that lose you qualified technical people before and after you hire them. Here are key don'ts.

DON'T take too long to make up your mind. Promise and give a definite answer within a very few days. As a man in demand, the electronics engineer has many op-

Table 1—How Engineers in Four Work Groups Rank Job Choice Factors

Factor	Research	Design	Production	Management
Type of work	52.1%	45.0%	41.8%	41.1%
Salary	31.3	37.8	32.9	34.0
Location	33.6	30.2	33.6	27.1
Opportunity for advancement	22.6	27.7	32.2	39.5
Challenge, more responsibility	18.5	17.0	19.2	18.7
Reputation, prestige of company	9.1	13.6	15.8	14.9
Working conditions, personnel	14.0	11.9	10.3	9.6
Growing organization, field	6.4	5.8	7.5	8.4
Security, retirement provisions	7.2	6.3	3.4	6.9
Opportunity to learn	11.3	6.0	7.5	5.9

portunities. Streamline your company's decision-making process if necessary, so you will not lose good men who tire of waiting.

DON'T fail to give *some* answer as rapidly as possible. A common complaint among engineers and scientists is being kept in limbo by companies that never reply to their resumes or letters, or fail to let them know that an opening for which they were considered has been filled.

DON'T be coy about salary. A major electronics firm recently advised all engineers in this field to learn not only initial salary when being interviewed for a position, but also the upper limits in their own category and how technical salaries in the company compare with administrative salaries at the same levels. Be prepared to be specific on such questions.

DON'T promise the moon . . . unless you can deliver. Overselling the positions you have only results in creating disgruntled engineers and scientists who will soon be looking for other work.

DON'T be a "me, too" company. Every firm has its own character and special advantages. Analyze what unique assets you have to offer from the technical man's viewpoint, then stress them. Such factors as a high ratio of technical aides, special assistance in publishing papers, unusually effective internal communications among the technical staff may weigh the scale in your favor.

DON'T forget to follow-up a few months later on men who have not accepted your offers. Circumstances may have changed. Even if they have not, you have expressed your company's continuing interest in the individual.

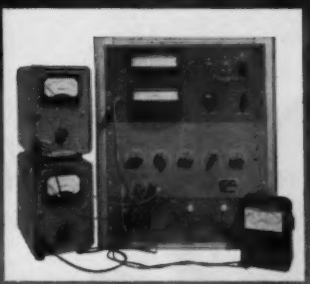
And, a final important *don't*—don't forget that *every* contact with an engineer or a scientist has effects beyond the contact itself.

The professional grapevine, as our studies show, is still the most heeded information source about companies as employers.

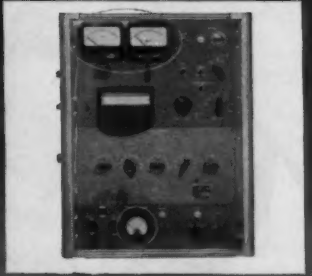
Poor treatment of technical people soon becomes well known; good treatment — courteous, competent, frank, and considerate—helps create a good recruitment image for your company that pays dividends in future hiring.

IRE Booth 3033

customize efficiency & accuracy with trio labs' **BUILD-IN** *instruments*



BEFORE . . . 3 external instruments were used to measure AC and DC voltages . . . cluttered, tedious, wasteful, subject to error.



AFTER . . . 3 trio instruments VTVMs integrally built-in now are always on hand to measure just the parameters you designate.

the industry's pioneer & complete line of

MINIATURIZED ELECTRONIC INSTRUMENTS

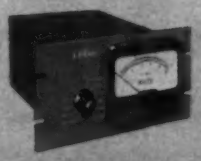
MILITARY
for MIL-E-5400A & MIL-T-945A applications.

COMMERCIAL

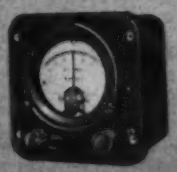
B Series ruggedized single-range AC VTVMs $160.

E Series Single-range AC VTVMs $99.50

D Series ruggedized multi-range AC VTVMs $272.

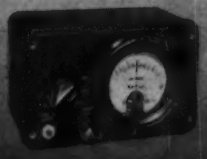


Model 109-1 low-level multi-range AC VTVM $199.



G Series ruggedized single or multi-range DC VTVMs $136.

F Series single-range DC VTVMs $84.50



J Series ruggedized low-level multi-range DC VTVMs $450.

Model 125-1 Null Meter $125.

By *building-in* trio labs' panel-mounting instruments you . . . customize test systems, set-ups and instruments; save space (average model is 4" x 4" x 4"); save time with at-a-glance monitoring; save money; make monitoring foolproof ("go-no go"); improve system reliability; increase overall design freedom. Choose from many "standard" or "special" models — or consult us for new designs for your needs. Write for free "how to" Engineering Guide to Dept. E-3

trio®

Trio Laboratories, Inc. Plainview, Long Island, New York

For High Accuracy—Broad Band Noise-Figure Measurement

KAY *Therma-Node*

Basic Noise Source
CAT. NO. 770

Available Noise
Accurate to ± 0.1 db

3 Noise Heads
Cover 1 kc to 1000 mc

Portable
Can be Operated from
117 V, 60 cycles or 24 V dc

Through refinement of a basic noise generation technique—thermal noise from a heated resistive element—the new Kay *Therma-Node* achieves high accuracy over an extremely wide range of frequencies. *Therma-Node's* resistive element, contained in the noise head, is heated to a normal 2200° K, generating adequate noise-power for accurate noise figure measurements to 10 db. Nominal fixed available noise temperature ranging between 2000 and 2400° K may be read directly on the panel meter to 2% accuracy. A single tuning element, contained in the noise head, provides a fixed range of 2 to 500 mc, and may be tuned to extend the range to 1000 mc. An optional, interchangeable head extends measurement down to 1 kc. Ambient termination is supplied. Both heads have output impedances of 50 ohms, unbalanced. Both heads can be used without connecting coaxial cables, thus eliminating cable errors.

A selectable-impedance noise head, covering the range .25 to 400 mc, and furnishing output impedances of 50, 100 and 200 ohms, balanced and unbalanced, is available as an accessory.

The inexpensive resistive element in the *Therma-Node* noise head has a life expectancy of 10,000 hours in either intermittent or continuous service. Because the few active components in the *Therma-Node* are solid state devices, its inherent stability results in long term accuracy and freedom from maintenance.

SPECIFICATIONS

STANDARD NOISE HEAD: (Head A furnished with **Therma-Node**), covers 2 to 1000 mc; output impedance 50 ohms, unbalanced N type connectors.
Max. VSWR, variable tuned, 1.1 from 10 to 1000 mc.
Max. VSWR, fixed tuned, 1.1 from 10 to 100 mc; 1.2 from 6 to 300 mc; 1.4 from 4 to 400 mc; 2 from 2 to 500 mc.

INTERCHANGEABLE LOW FREQUENCY NOISE HEAD: (Head B), covers 1 kc to 350 mc; output impedance 50 ohms, unbalanced.
Max. VSWR 1.1. from 3 kc to 100 mc; 1.2 from 2 kc to 250 mc; 1.4 from 1 kc to 350 mc.

AMBIENT SOURCE PROBE for use with A and B Noise Heads:
Frequency range—0 to 1000 mc.
Output impedance—50 ohms, unbalanced.
Max. VSWR-1.1.
Accuracy of indicated temperature—±1%.

SELECTABLE-IMPEDANCE NOISE HEAD: (Head C) covers 0.25 to 400 mc, balanced or unbalanced output. Selectable output impedances of 50, 100 and 200 ohms are provided.
Max. VSWR—1.1 from 1 to 75 mc; 1.2 from 0.5 to 100 mc; 1.4 from 0.25 to 400 mc.
Max. VSWR difference between ambient and hot source is 0.05 (hot and ambient sources contained in same probe).
Weight: 8 pounds in carrying case.
Dimensions: 11.5 x 8 x 4.75 inches.
Operates on 117 V, 60 cps, or 24 V dc.
Price: $495.00, f.ob. factory.
Low frequency Noise Head (B): $175.00.
Selected Impedance Head (C): $125.00.

OTHER KAY NOISE GENERATORS

Instrument & Cat. No.	Frequency Range (mc)	Noise Figure Range (db)	Output Impedance (ohms)	Price f.o.b. factory
Mega-Node 240-B	5-220	0-16 at 50 ohms 0-23.8 at 300 ohms	unbal.—50, 75, 150, 300, ∞ bal.—100, 150, 300, 600, ∞	$365.00
Mega-Node 175-A	50-500	0-19	balanced—300	$365.00
Mega-Node 403-A	3-500	0-19	unbalanced—50	$365.00
Mega-Node 3000	1-3000	0-20	unbalanced—50	$790.00
Rada-Node 600-A	5-400	0-23.8 depending on impedance	unbalanced as specified	$1495.00
	10-3000	0-20	unbal. nom. 50	$1965.00
	1120-26,500	15.28 or 15.8	waveguide	†
*Microwave Mega-Nodes**	1120-26,500	15.28 or 15.8	waveguide	$175.00 to $595.00

† Price varies with **Microwave Mega-Node** used as accessory.
* Ideally suited for noise figure measurement in radar communication.

WRITE FOR NEW KAY CATALOG

SEE US AT THE IRE SHOW
BOOTHS 3512, 14, 16, 18

KAY ELECTRIC COMPANY
Dept. E-3 Maple Avenue, Pine Brook, N. J. CApital 6-4000

TYCHO

OR BUST

Pick a crater. Tycho, Clavius, or you name it. Design a vehicle that will hit it, right between the ringwalls. When you choose subsystem suppliers to contribute to that kind of accuracy, check this out: Giannini's systems capability is based on ample depth of experience in **Air Data Instruments, Inertial Instruments, Servo Components.** From that depth comes a standard of performance best appreciated by those whose projects depend on Giannini subsystems daily, for better measurement and control, everywhere on earth and above it.

GIANNINI CONTROLS CORPORATION

A NAME TO PLAN WITH

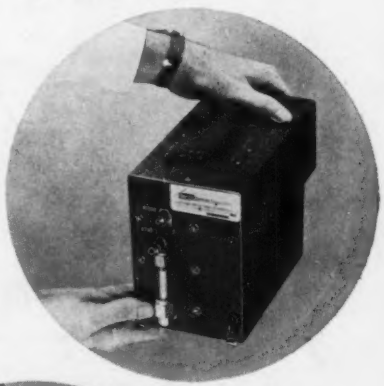
THESE AND DOZENS OF OTHER MEASUREMENT AND CONTROL SUBSYSTEMS IN DAILY OPERATION HAVE BUILT THE GIANNINI REPUTATION FOR FAST, KNOWLEDGEABLE DEVELOPMENT OF SYSTEMS

A "GUN BARREL" HALF-A-MILE LONG

The need was for a new inertial platform. Small and light enough for tactical missiles. Yet able to keep the boost trajectory gun-barrel-straight and the impact dispersion small. • First to answer the need was Giannini with a revolutionary new inertial system you can hold in your hand . . . and which costs one tenth as much as full guidance. • This startling development is made possible by Giannini's diversified capabilities and is based on two exclusive Giannini components. A miniature free gyro. And an ultra-miniaturized accelerometer which senses very small lateral accelerations, yet ignores the high g's of boost thrust.

PITCH TRIM COMPENSATOR FOR DC-8 JETLINER

Problem . . . As aircraft proceed into the transonic speed range, aerodynamic trim characteristics change. An adjustable Mach computer and power package were needed to deliver corrective force at the pilot's control column. • Solution . . . Giannini delivered a small, highly accurate servocomputer-controller with a pulse-modulated output. • Douglas now specifies the Giannini Trim Compensator system as standard equipment on every DC-8 delivered.



THREE-AXIS RATE GYRO SYSTEM FOR TITAN

Flight stabilization of the Martin Titan required a package gyro system—to provide the highest degree of performance stability, accuracy and reliability under severe environmental conditions. • Giannini met the requirement by designing a three-axis gyro system for flight control and for telemetering pitch, roll, and yaw rates. Two of these subsystems are used in every Titan.

THIS MAKES GOOD SENSE: HE WHO KNOWS MOST ABOUT ALL THE PARTS CAN BEST PUT THEM TOGETHER INTO A WHOLE THAT WORKS. ONLY GIANNINI HAS PROVEN EXPERIENCE IN SUPPLYING ALL OF THESE COMPONENTS

AIR DATA INSTRUMENTS

Giannini Air Data Instruments offer you the widest choice in the industry. For years they have set avionic standards and served as building blocks for control and flight test subsystems. The Air Data line includes: **Absolute, Differential and Gage Pressure Transducers — Servoed Pressure and Pressure Ratio Instruments — Probe and Vane Sensors.** All give evidence of a progressive engineering philosophy that emphasizes originality, simplicity, flexibility.

SERVO COMPONENTS

The Giannini line of precision potentiometers and special electromechanical devices meet standard and special needs for all types of high-performance servo systems. Included are: **Precision Potentiometers.** Linear and non-linear. Single-turn and multi-turn rotary. Low-torque models. Rectilinear units with or without spring loading. Unique Spiralpot® with infinite resolution from a wirewound element. **Stepping Motors — Segmented Torquers — Milliwatt Motors.** More reasons why Giannini serves aerospace engineering/management fast and well...in design, liaison, production, field service.

INERTIAL INSTRUMENTS

Success in the design and production of inertial instruments puts a premium on the maker's experience. For more than a decade, Giannini has been developing outstanding inertial components for the nation's missiles and spacecraft. The line includes: **Gyros, Rate and Free.** High-level AC or DC output. AC and DC electrically powered rotor. Pyrotechnic rotor. High reliability in presence of unfriendly environments. **Accelerometers, Linear and Statistical.** Environments: normal, high-temperature, intense nuclear radiation. **Integrating Acceleration Switches.** Used by virtually all major prime contractors in scores of world-wide projects.

FACILITIES . . . A PLANNED FLEXIBILITY

Every Giannini product is designed to solve a specific problem. Often, a problem never before solved. This calls for utmost flexibility. In design. In manufacture.

At Giannini, flexibility is management-planned and management-guided with emphasis on these basics: Qualified personnel. Continuous training. A core of proved principles and procedures. Awareness of schedules. Control of critical processes. Responsibility with authority.

These basics guide the work of all Giannini departments and echelons. You benefit from them when you choose Giannini as your contractor for advanced subsystems management and creative development programs.

SALES ENGINEERING OFFICES

Ask a Giannini representative to call for a friendly, informative talk about your system and component needs. You'll find he has been selected for high technical competence and for his attitude of helpful service.

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918 East Green Street
Pasadena, California
MUrray 1-7152
SYcamore 3-2101

ILLINOIS
8 South Michigan Avenue
Chicago 3, Illinois
ANdover 3-5272

NEW YORK
Empire State Bldg.
New York 1, N. Y.
CHickering 4-4700

OHIO
3524 Blocker Drive
Dayton 20, Ohio
AXminster 9-7383

WASHINGTON
2558 Westpath Way
Washington 16, D.C.
OLive 4-0047

TECHNICAL LITERATURE

Like a parabolic antenna to the space pilot, case studies and other Giannini technical literature focus valuable information and guidance for those with advanced design and project responsibilities. Please order by title or number.

System Case Studies

1. Trim Compensator for Jet Liner
2. Stall Warning System for Douglas Cargomaster
3. Compact True Airspeed Computer for Rugged Environment
4. Voltage Monitor for Telemetry System
5. Engine Pressure Ratio System for Jet Aircraft
6. Null Balance Transducer System

Component Data

7. Air Data Instruments
8. Inertial Instruments
9. Servo Components

Monthly Mailing

10. Giannini Technical Notes

Giannini Controls Corporation 918 East Green Street, Pasadena, Calif.
A NAME TO PLAN WITH

Explore new career openings. Write to Giannini's Director of Technical Personnel.

See these and other products for systems engineering at the Giannini display, Booths 1428-30, I.R.E. Show, New York Coliseum, March 21-24.

International IRE

IRE committee members offer tips on . . .

How to See the Show

George W. Bailey, Chairman, IRE General Committee

• Study the *Guide* for an overall picture of the show.

• Note that the exhibits are divided into three sections:

First and second floors—components.

Third floor—complete equipment, test instruments and systems.

Fourth floor—production items.

• Use the map to plan a route along the "avenues" that interst you.

• Study the "Product Information Service Section" for locations of exhibits.

• Your registration is for the entire IRE convention; once registered you are admitted to all technical sessions and to all of the exhibits by showing your badge.

Leo J. Chamberlain, IRE Registration Committee

• Key to success is to have a well worked out plan of attack. Study pre-publicity about the show prior to going. Be certain to jot down equipment and speeches of interest.

On arrival, study *Guide* book for:

• General organization of exhibits.

• Specific exhibitors of equipment in your field of interest (from Product Information Service section of *Guide*).

• If the list of exhibitors is long, read description of equipment on display under company listing in "Whom and What to See," and check those of most interest.

• See main competitors.

• Look over Index to Session Topics for technical papers.

• Check titles of papers of interest; read abstracts to weed out those less rewarding to you. Take a quick look at papers in seemingly unrelated fields for possible connection with your interest. This step often pays dividends.

• Coordinate your exhibit time with time and location of technical sessions.

• And, finally, in the rush of the convention, don't forget this: coordinate your exhibit time with time and location of technical sessions.

Raymond E. Lafferty, IRE Hospitality Committee

• Using the *Guide*, list exhibits of interest to you.

• Map out the shortest route to cover these exhibits.

• Check in the *Guide* exhibits of special interest.

• After completing your initial tour, start a systematic inspection of the entire show, particularly those booths checked during the first tour.

• Have a pocket stamp made with your name, position, company affiliation, and address for filling out literature request forms.

• Wear comfortable shoes.

• Inquire at the Hospitality Desk in the Silver Corridor of the Waldorf-Astoria, about tickets for radio and tv broadcasts and for guided tours around town.

E. K. Gannett, IRE Publicity Committee

Before the convention:

• Study program of papers, exhibits and special events. Work out tentative time schedule.

• Watch the various technical journals for special late announcements.

• Send in reservations in advance for cocktail party and banquet.

During convention:

• Register immediately and get convention *Guide*.

• Study *Guide* thoroughly, particularly "Products Information Service Section" in rear where exhibits are listed by equipment.

• Plan to make at least two trips to the Coliseum: one, a quick trip of the whole show, making notes of exhibits of interest; two, go back to exhibits of special interest.

• Start out on the top floor and work down; physically, it's easier.

• Before leaving convention, place orders for technical papers you want at the convention desk at either the Coliseum or the Waldorf.

TEKTRONIX®

2 NEW

TYPE 503

The Type 503 is a differential-input X-Y oscilloscope with the additional features—linear sweeps, dependable triggering, sweep magnifier, bright trace, amplitude calibrator—desirable for general-purpose applications.

FREQUENCY RESPONSE
dc to 450 kc

VERTICAL AND HORIZONTAL AMPLIFIERS
Differential input at all attenuator settings.
1 mv/cm to 20 v/cm in 14 calibrated steps.
Continuously variable between steps, and to approximately 50 v/cm uncalibrated.
Constant input impedance at all sensitivities (standard 10X probes can be used).

SWEEP RANGE
1 μsec/cm to 5 sec/cm in 21 calibrated steps.
Sweep time adjustable between steps, and to approximately 12 sec/cm uncalibrated.

SWEEP MAGNIFICATION
X2, X5, X10, X20, and X50 Magnification.

AMPLITUDE CALIBRATOR
500 mv and 5 mv peak-to-peak square-wave voltages are available from front panel.

3-KV ACCELERATING POTENTIAL
5-inch Tektronix crt provides bright trace, 8-cm by 10-cm viewing area.

EASY TRIGGERING
Fully automatic, amplitude-level selection on rising or falling slope of signal, or free-run (recurrent). AC or DC coupling, internal, external, or line.

REGULATED POWER SUPPLIES
All critical dc voltages electronically-regulated, plus regulated heater supplies for the input stages of both amplifiers.

SIZE AND WEIGHT
13½" h, 9¾" w, 21½" d—approximately 29 lbs.

TYPE 504

The Type 504 has the basic features desirable for most general-purpose applications—sensitive vertical amplifier, linear sweeps, easy triggering, amplitude calibrator.

FREQUENCY RESPONSE
dc to 450 kc

VERTICAL AMPLIFIER
5 mv/cm to 20 v/cm in 12 calibrated steps.
Continuously variable between steps, and to approximately 50 v/cm uncalibrated.
Constant input impedance at all sensitivities (standard 10X probe can be used).

SWEEP RANGE
1 μsec/cm to 0.5 sec/cm in 18 calibrated steps.
Sweep time adjustable between steps, and to approximately 1.2 sec/cm uncalibrated.

AMPLITUDE CALIBRATOR
500 mv and 25 mv peak-to-peak square-wave voltages are available from front panel.

HORIZONTAL INPUT
0.5 v/cm, with variable attenuator.

3-KV ACCELERATING POTENTIAL
5-inch Tektronix crt provides bright trace, 8-cm by 10-cm viewing area.

EASY TRIGGERING
Fully automatic, amplitude-level selection on rising or falling slope of signal, or free-run (recurrent). AC or DC coupling, internal, external, or line.

REGULATED POWER SUPPLIES
All critical dc voltages electronically-regulated, plus regulated heater supplies for the input stages of the vertical amplifier.

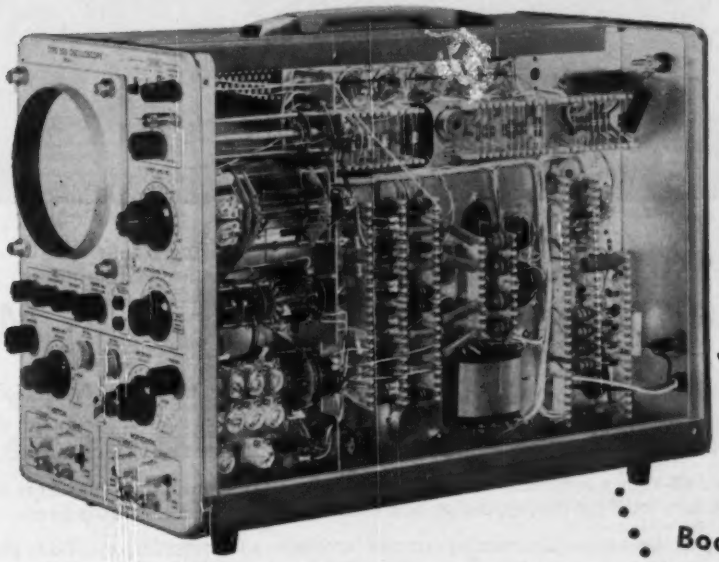
SIZE AND WEIGHT
13½" h, 9¾" w, 21½" d—approximately 29 lbs.

GENERAL-PURPOSE Oscilloscopes

Introduce TEKTRONIX QUALITY to the DC-to-450 KC RANGE

The Tektronix Type 503 and Type 504 are the first of a family of new oscilloscopes for the DC-to-450 KC application area.

- ★ **Both feature high reliability, simple operation, light weight.**
- ★ **Each excels in performance characteristics in its class.**
- ★ **Both *now* established as production instruments.**



Rack-mounting models will be available, of course!

Prices for Types 503, 504 to be announced at the IRE Show Booths 3027 to 3030.

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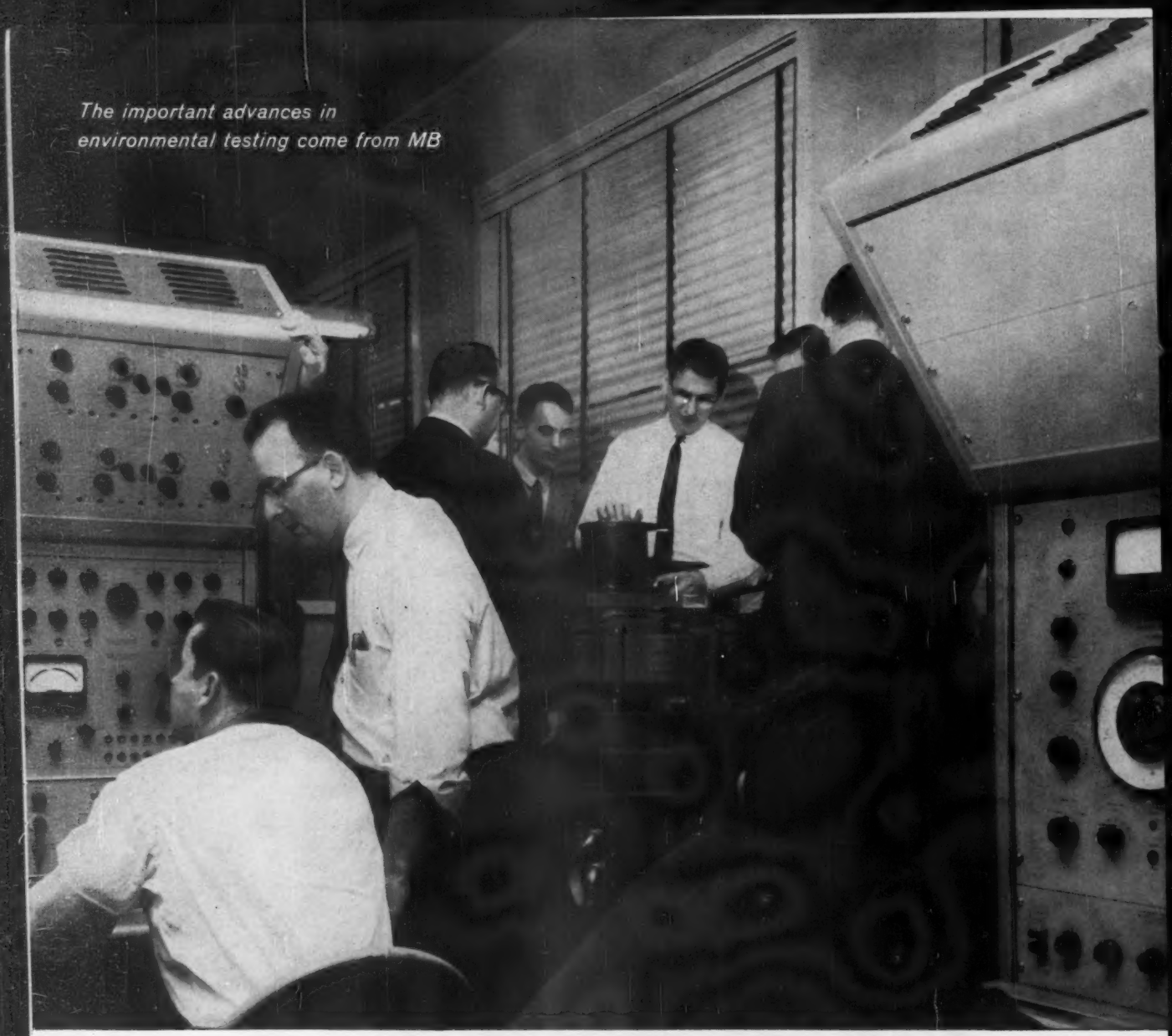
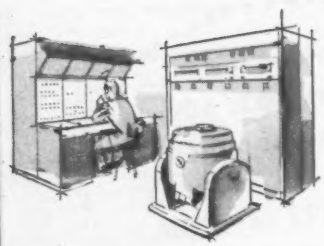


NEW seminar series in practical vibration testing starts April at MB



Attendance at MB seminars is limited to 12 students per session in order to provide all with ample opportunity to enter discussions and receive full benefit of laboratory equipment.

EVERY month 12 students "graduate" from MB's seminar in Complex Vibration Practice.

They return to the complex world of aircraft, missiles and electronics better equipped to handle the increasingly complicated requirements of vibration testing.

These well-known seminars were inaugurated by MB to familiarize engineers and technicians with the theory, design and operation of complex test equipment.

Results of these valuable training courses have been so successful that MB is pleased to announce a new series to run concurrently with the seminar on theory. The new seminar, starting this April, will emphasize practical application of test equipment.

The initiation and continuance of these seminars is another demonstration of MB's leadership in the field. They are good reasons why *more and more engineers look to MB for continuing progress in the field of environmental testing.*

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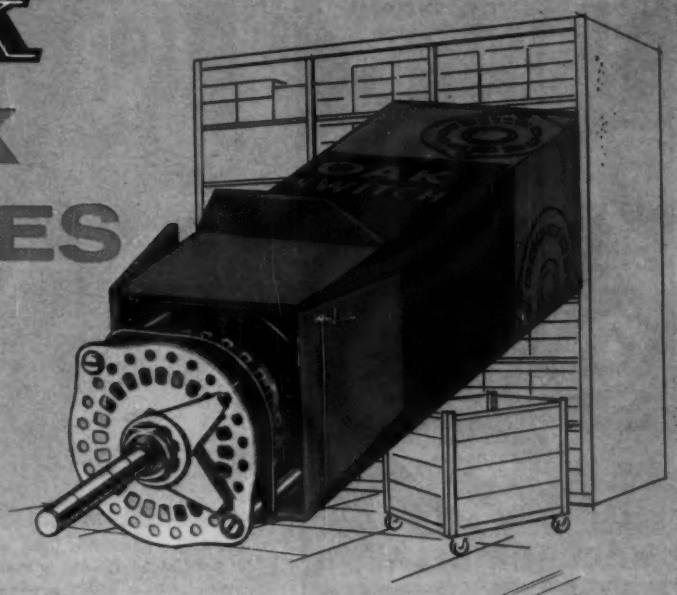

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New subminiature Model BR-9, meets Mil R 5757C, 25018, with vibration to 30g @10 – 2000 cps, 50g shock @11 millisec over –65°C to 125°C range. Bulletin BR-594.

BABCOCK BR-1S RELAY

Miniature, hermetically sealed BR-1SZ requires only 5 mw power, features very critical pull-in to drop-out ratios, 100,000 op. min. and –65°C to 125°C ranges. Meets Mil R 5757C, 6106C, 25018. Bulletin BR-593.

BABCOCK RELAYS

BABCOCK BR-7 RELAY

Subminiature 10 amp, DPDT relay with 0.2" grid spaced header accepts 30g vibration @10 – 2000 cps, 50g shock @11 millisec. over range of –65°C to 125°C. 100,000 op. min. @+125°C. Meets Mil R 5757C, 25018. Bulletin BR-592.

BABCOCK BR-8 RELAY

Subminiature A. C. or D. C. crystal can relay, 250,000 op. min. @+25°C. Vibration, 30g, 40 – 2000 cps. at –65°C to +125°C. Available with adjustments for repeatability over millions of operations. Meets Mil R 5757C, 25018. Bulletin BR-591.

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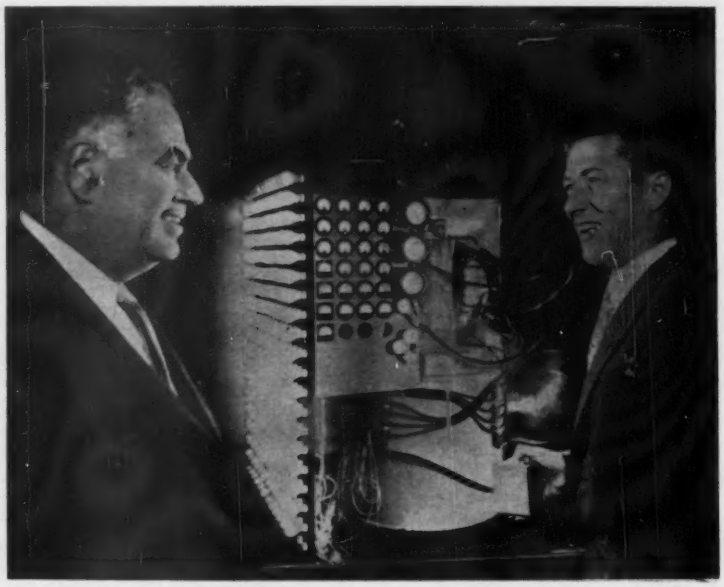
IRE SHOW BOOTH M-15

MAGNETOHYDRODYNAMICS . . .

A Research Field to



Dr. Arthur Kantrowitz (left), director of the Avco-Everett research lab, and Dr. Richard J. Rosa, senior scientist in charge of experiment, view company's experimental magnetohydrodynamics (MDH) power generator as it successfully lights a bank of 228 50-watt bulbs for first time

THE FIELD of magnetohydrodynamics—MHD—is taking on new significance for the electronics industry this week.

Three main spheres of activity bear watching:

1. R&D on ion propulsion of space vehicles.
2. Development of a controlled nuclear fusion reactor.
3. Improved designs for MHD generators, making them competitive with existing electrical power sources.

These developments were highlights at the MHD symposium held recently, by the basic science committee of the AIEE, at the University of Philadelphia.

Surprising Attendance

Attendance at the meeting far exceeded expectations. More than 300 persons were present. This is three times the number such a symposium would have attracted a year ago, officials said.

It was evident at the meeting that the range of interest in MHD is rapidly expanding. Aircraft companies are interested in flight applications and power conversion. Universities and research foundations are active in fusion research. Utility companies are wondering how soon a practical rotationless generator will become available.

Magnetohydrodynamics is the study of plasma physics, or, loosely defined, the study of ionized matter.

The papers presented at the symposium were divided into four main categories. One category was communications and diagnostics, which was concerned with the fundamentals and measurements. For example, how well can information signals be transmitted through the plasma sheath surrounding a reentry space vehicle? A second session dealt with application-research into methods of converting the energy in a plasma into electrical energy, without use of gas turbines and generators.

'Electronic Rocket'

A third session was directed at research on devices for harnessing the energy of nuclear fission. Here

Watch

the problem is to contain the plasma at the very high temperatures necessary for fusion to be self-sustaining. Thus far, strong magnetic fields offer the best promise of bottling up the fusion process, whose temperatures would otherwise destroy existing man-made containers.

The last session investigated flight applications of MHD. Research work indicates the feasibility of practical thrust generators using electrical energy to accelerate atomic particles to produce thrust in much the same way as does a rocket engine. With relativistic velocities, comparatively few ions would need to be expelled from a space vehicle's electronic rocket to contribute sufficient thrust to control the vehicle.

English Radar Unit To Tour Europe

LONDON—These items are in the electronics industry news this week:

• Associated Electrical Industries Ltd., of London, is sending a specially-designed marine radar unit on a five-month tour of eight European countries to boost exports.

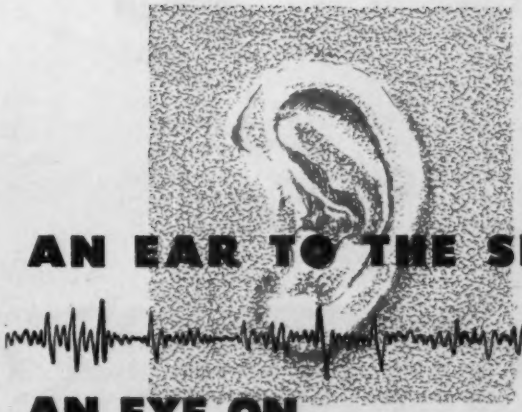
Nations to be visited include Belgium, Holland, Germany, Denmark, Sweden, Norway, France and Italy.

• Duplicate 10-centimeter surveillance radar transmitters with four display consoles have been ordered from Cossor Radar and Electronics Ltd., of London, by the Yugoslav government for Belgrade's air terminal.

Two of the four displays will be used by air traffic control operations. The others will be for approach control and monitoring.

• A four-camera mobile outside broadcast van, ordered from EMI Electronics Ltd., of Hayes, will be delivered in June to the Hungarian Broadcasting Authority.

Four sound and video outputs from the vehicle allow independent distribution of signals to monitors when the vehicle operates as a studio control room.



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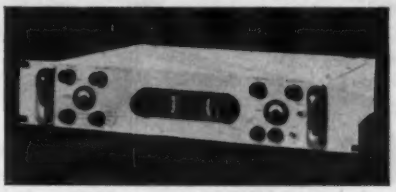

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Tuning Range ..... 30-260mc (two bands: 30-60mc, 60-260mc switched)
Noise Figure ..... 6db maximum
Input Impedance ..... 50 ohms unbalanced to Type N connector on rear apron
IF Rejection ..... 65db minimum
Image Rejection ..... 60db minimum
IF 21.4mc
IF Bandwidths: 300kc, 20kc (switchable from front panel)
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Size ..... 19" wide, 3½" high, 15" maximum depth

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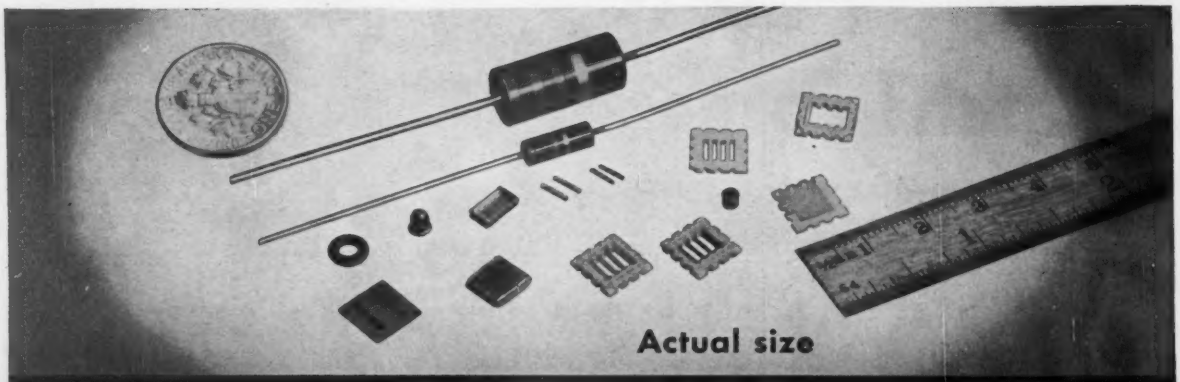
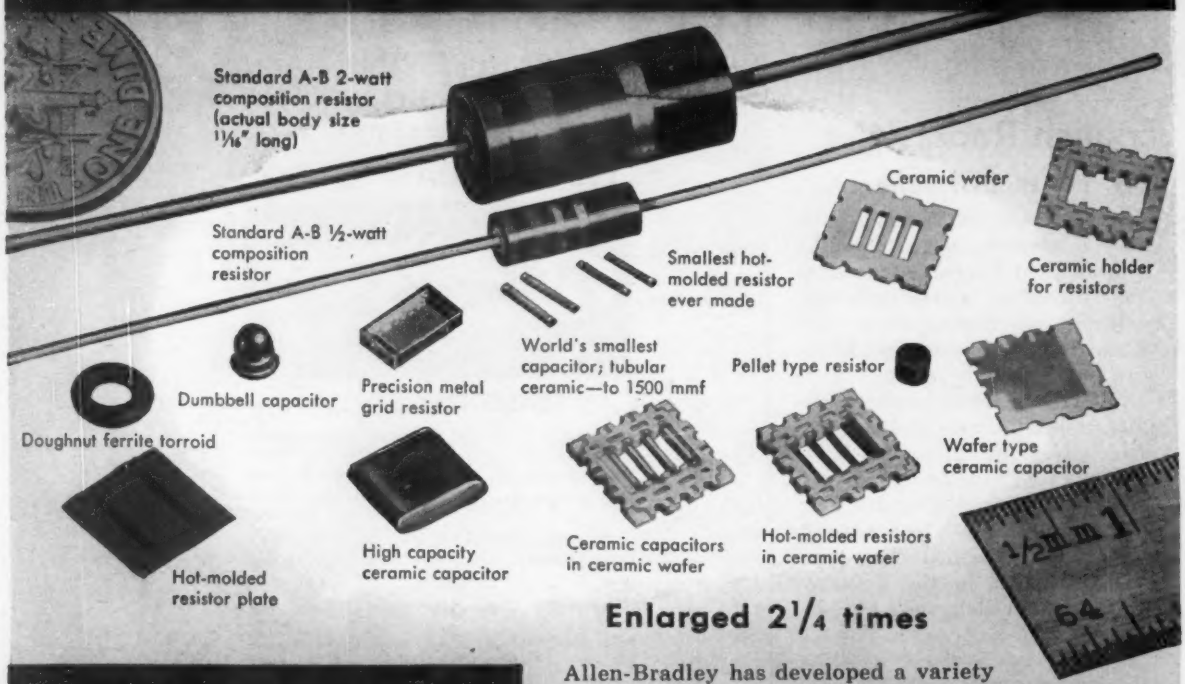


Micro-Miniature Components

with traditional Allen-Bradley Reliability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Doughnut ferrite torroid
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High capacity ceramic capacitor
Ceramic capacitors in ceramic wafer
Hot-molded resistors in ceramic wafer

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ALLEN-BRADLEY

Quality
Electronic Components

Allen-Bradley has developed a variety of remarkable micro-miniature components. These components include standard types for wafer configurations, as well as several unique units which would seem to hold extremely interesting possibilities for future developments. In addition, A-B research has succeeded in removing the major hurdle in connection with consistent "reliability." This permits the production of fantastically small components. For example, the hot-molded resistors for wafer mounting are only 0.155" long and 0.025" in diameter.

These achievements in the field of micro-miniature components typify the advanced engineering at Allen-Bradley. Naturally, we'll be very happy to help you with your miniaturization problems.

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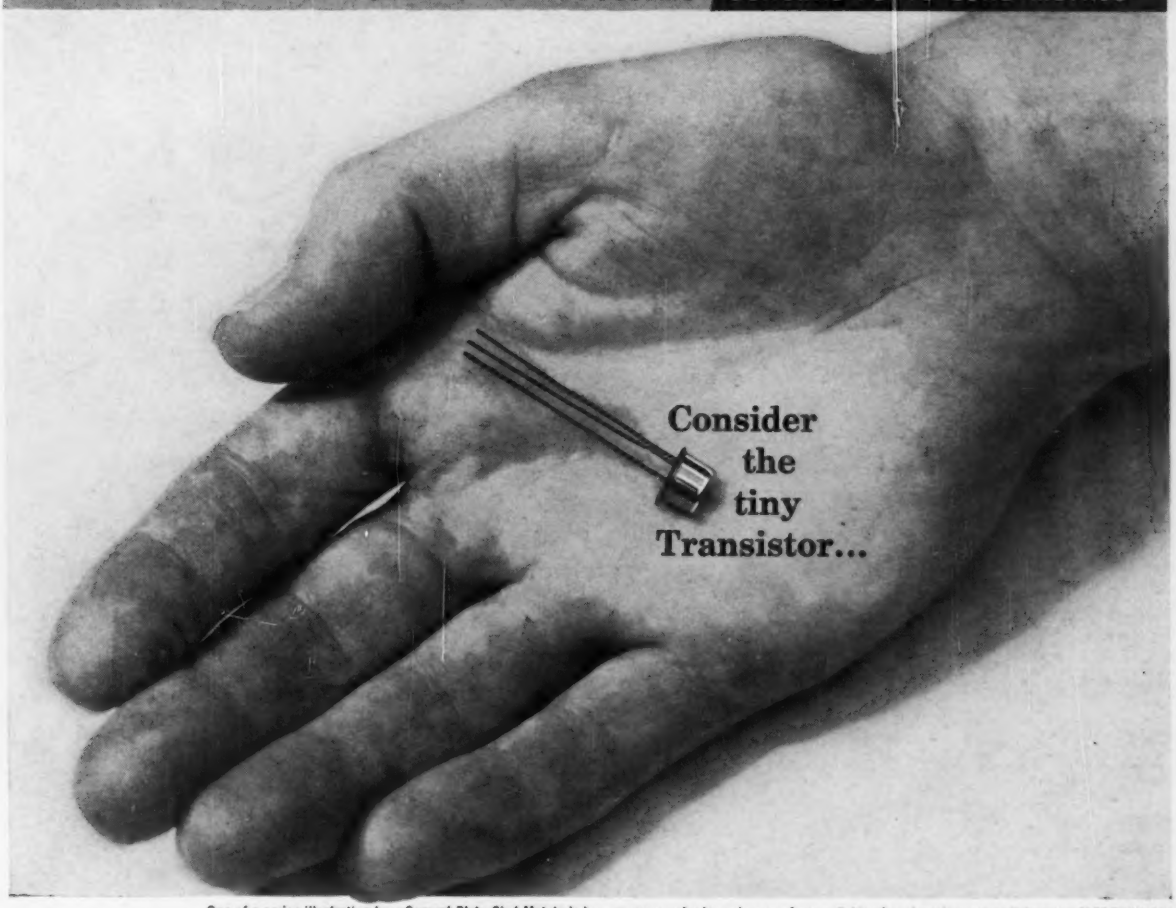
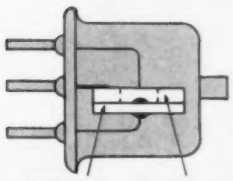


One of a series illustrating how General Plate Clad Metals help uncover new horizons in one of many fields of engineering accomplishments: ELECTRONICS!



Tin clad nickel used as germanium cradle base tab support. The strength of nickel and the solderability of tin combine to solve a variety of physical and mechanical problems.

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USED IN NEW AND DIFFERENT WAYS

Among the important contributions to the success of transistors is the use of General Plate tin clad nickel used as the germanium cradle base tab support. In this one piece of clad metal, the strength of nickel and the solderability of tin were combined to solve a variety of physical and mechanical problems. This made it possible to eliminate expensive hand assembly of minute pieces, or electroplated material that might contain gas or present a porous surface with resulting unsatisfactory performance.

General Plate tin clad nickel is but one of over 400 different combinations of clad metals available which are finding wide use in industry after industry. New combinations are being developed constantly.

No matter what your metal problem, it will pay you to consult with Metals & Controls Division Engineers. Their vast experience in cladding precious to base or base to base metals can overcome your metals engineering problems with multiple property requirements . . . often reduce costs, too. Write for information today.

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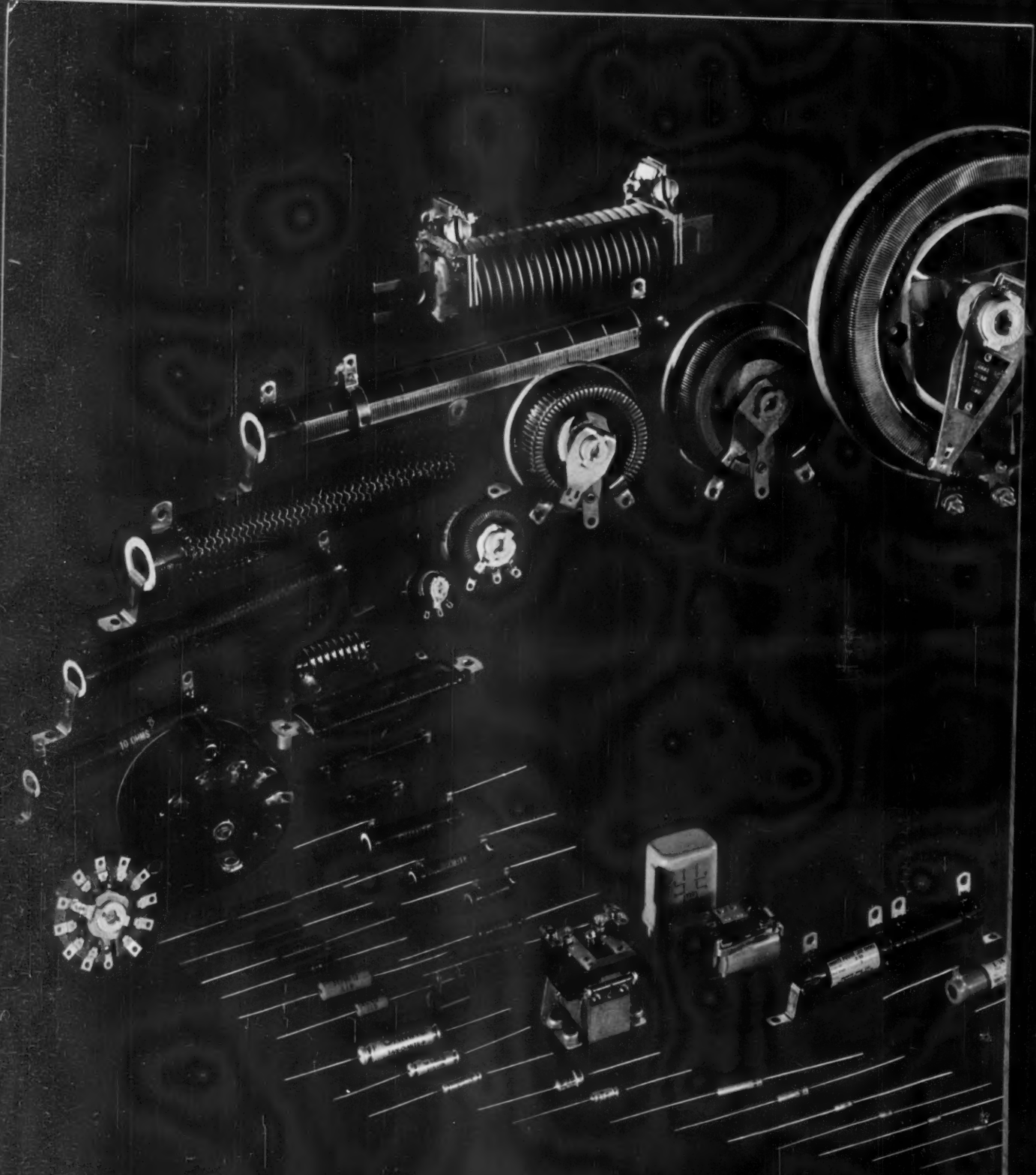

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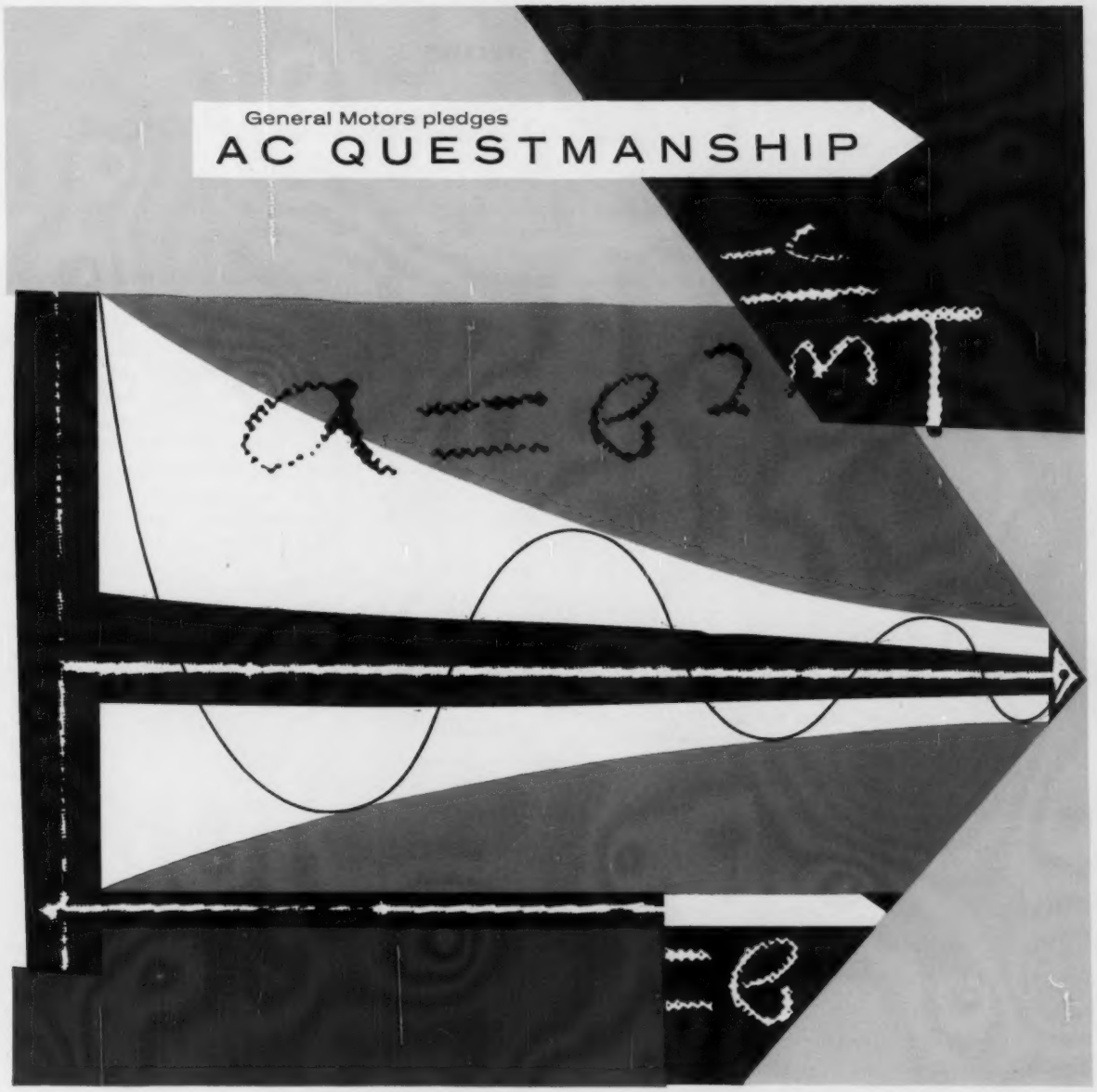

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The KP-80 is the first ion deflection thyratron. It is a triple control coincidence tube which greatly simplifies control circuitry. The tubes have three control electrodes for *double-* or *triple-*coincidence circuit functions.

The tubes are used in computers, automation control apparatus, conveyor selector systems, coding and programming devices, counters, etc.

In addition to the customary shield, there are two symmetrical control electrodes which have equal sensitivity. In double - control circuits, a signal on only one grid (up to and exceeding plus 40 volts) will not fire the tube, but small (4.5 volt) simultaneous signals on both grids cause conduction. In triple control circuits, three simultaneous signals are required for conduction and signals (up to 20 volts) applied to any one or two grids will not fire the tube. More than a dozen circuit components are eliminated by the KP-90 in double control circuits, and triple coincidence circuits eliminating more than two dozen precision components are also possible. The KP-80 has a 6.3 volt, 150 mA heater cathode, with an anode operating voltage of 150 v.

Actual Size

A subminiature tube, the KP-150 is also available for double coincidence and indicating circuits.

For further details on these and other Special Purpose Electron tubes contact KIP ELECTRONICS CORPORATION, DEPT. 612, BOX 562, STAMFORD, CONNECTICUT.

ACADEMICALLY SPEAKING

Schools Map New Projects

OUR NATION'S academic research laboratories are continuing to open new areas and widen others in today's world of electronics. Here are some examples this week:

• **University of Arizona,** Tucson, reports receipt of a three-year grant by the National Science Foundation. Subject of the study is "A Physical Model for the Lightning Discharge." Professors Walter H. Evans and Robert L. Walker will investigate electromagnetic energy radiated during lightning discharges.

They will also consider such related subjects as rapid spherics locators, the frequency spectrum of lightning, experimental attenuation of ULF radio propagation and charge separation between clouds.

Also reported is completion of contract negotiations with General Electric's Computer Division in Phoenix to sponsor an investigation into computer applications of tunnel diodes.

Additional work will be done on studies of the effects of radiation on digital tape information, and the development of a computer for controlling traffic in Tucson.

• **University of Cincinnati** announces certain work in progress is being sponsored by the Air Force and the Petroleum Research Fund. Studies involve the strength of chemical bonds and the conductivity of various chemical groups.

• **University of Kansas,** Lawrence, is continuing research on Project Jayhawk for the U. S. Army Signal Corps under a grant of more than $100,000. The contract provides continuance of the successful millimicrosecond studies known for several years by the above code name. Study involves the generation, detection and transmission of millimicrosecond electrical transients. These transient phenomena are considered basic to the development of future long-range radar systems, high-speed computers and nuclear instruments.

• **Columbia University,** New York City, discloses plans to use an electronic music synthesizer, developed by RCA, in a joint Columbia-Princeton project to examine the device's potential for creating new forms of music and sound. The synthesizer can reproduce any known instrumental sound, as well as any sound imaginable. A punched paper roll moving over electrical brushes actuates output circuits which record sound one tone at a time. The tones are blended by rerecording to give the desired effect.

Also at Columbia, the Safety Research Project at Teachers College plans to devote attention to the use of electronic controls in traffic safety. A special fund-raising effort is being made to finance the project. The first phase will attempt to raise $40,000 over a two-year period.

• **University of California** researchers at the Lick Observatory announce the start of a project aimed at collecting new information on the motions of gaseous nebulae. Observations will be made with a nebular spectrograph to be constructed under a $30,300 grant from the National Science Foundation. Design of the new spectrograph will permit the analysis of light given off by distant clouds of gas.

According to University astronomer George H. Herbig, the new instrument, when completed some 18 months from now, will be superior to existing equipment because of new developments in optical equipment. The nebular spectrograph will be used in conjunction with the 36-inch telescope at Mt. Hamilton, Calif. With it, the spectroscope should be able to provide information on the internal motions of gaseous nebulae, as well as on their movement in relation to other celestial objects.

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Ultra Sensitive Strain Sensing elements.

60 to 70 times greater Sensitivity than other metal strain gauges

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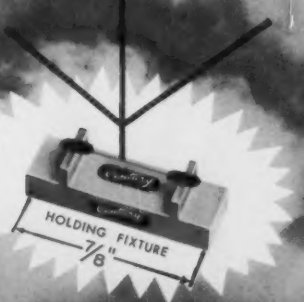

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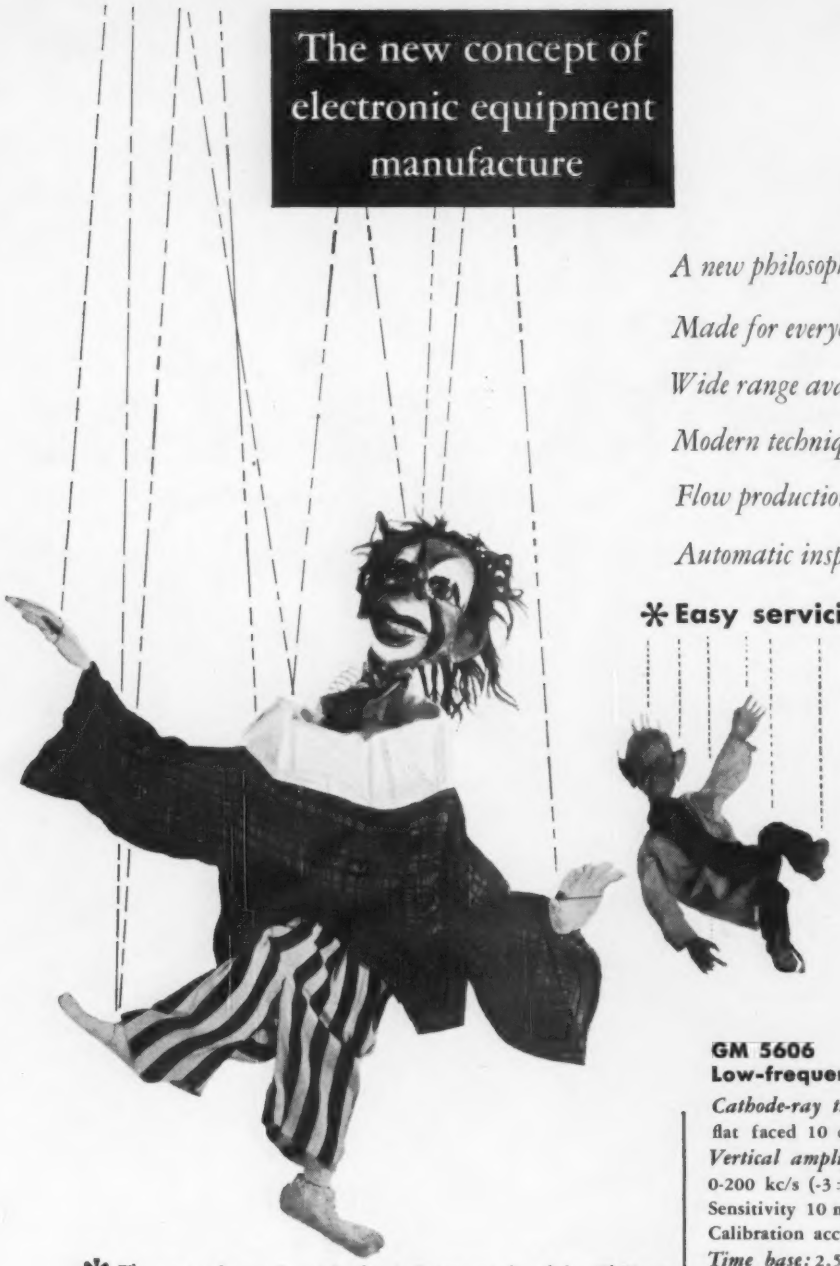

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Stereo Committee Suspends Activities

"THE DOOR is still partly open," is the way a spokesman from Electronic Industries Association describes the future of the National Stereophonic Radio Committee.

After much deliberation, EIA feels that no choice remains but to put NSRC in mothballs because of failure to achieve certain organizational goals considered indispensable.

'Wrong Time'

The committee, a group of manufacturers formed to establish specifications for broadcasting and receiving equipment for stereo, feels the FCC's crowded docket has been a major factor in the Commission's reluctance to become more heavily involved.

"It was just the wrong time," one EIA man told ELECTRONICS. "What with the Geneva conference on allocations, payola investigations, and the usual heavy workload, the Commission just wasn't ready to take more on."

What's Ahead

EIA still plans to file a full report to FCC on the work and findings of the stereo group. A considerable amount of work has been done on f-m stereo, plus some important beginnings on a-m, says the association.

It is likely that individual members of NSRC will continue to gather relevant data, each on his own specialty.

Meanwhile, FCC plans to hold f-m hearings some time after next Tuesday.

Regarding the future of a-m stereo, EIA feels that RCA and CBS will be able to contribute much when the climate becomes favorable for a free exchange of information among the FCC, the two companies and a stereo committee. These two firms did not join NSRC because of FCC's reluctance to occupy a chair on the committee in a way done during the work of the Television Allocations Study Organization.

THE NEW
IN VIEW!

At Martin-Denver exciting and vast new space engineering programs are in progress. These programs demand unusual creative talent. If you have this talent and want rapid professional advancement, please make this known to N. M. Pagan, Dir. of Tech. & Scientific Staffing, (Dept. JJ3), The Martin Company, P. O. Box 179, Denver 1, Colorado.

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MODEL AB-3-5

1 KC LIMIT BRIDGE

Very accurate (±0.3%) high speed component tester designed especially for incoming and final testing of resistors, capacitors and other electronic components. Offers many distinct advantages over unbalanced bridge testers using meter output. Single colored light indicates whether or not component meets preset limits. Not necessary for operator to interpret a meter reading. No drift. No necessity for continuous checking of zero and percentage limits. Complete freedom from changing vacuum tube characteristics and line voltage variations. Operator need only insert and remove component...no manual switching required.

For many applications semi-automatic and fully-automatic feeding and sorting devices can be provided.

SPECIFICATIONS

	RANGE	ACCURACY	PRODUCTION RATE
Capacity	100 $\mu\mu$f to 15 μf lower at reduced accuracy.	±0.3%	Depending on operator, 1500 pieces per hour would be a practical speed. Instrument capable several times this figure.
Resistance	10 ohms to 5 megohms, higher at reduced accuracy.	±0.3%	
Impedance	10 ohms to 5 megohms, higher at reduced accuracy.	±0.3%	

Write for detailed technical literature to...

Industrial Instruments Automation Corporation
89 Commerce Road, Cedar Grove
New Jersey

MEETINGS AHEAD

Mar. 17-18: Synchro Design and Testing Symposium, Bureau of Naval Weapons, Dept. of Navy, Dept. of Commerce Auditorium, Wash., D. C.

Mar. 21-24: Institute of Radio Engineers, International Convention, Coliseum & Waldorf-Astoria Hotel, N. Y. C.

Mar. 24-25: Human Factors in Electronics, PGHF of IRE, Bell Labs Auditorium, N. Y. C.

Apr. 3-6: National Assoc. of Broadcasters, Engineering Conf. Committee, NAB, Conrad Hilton Hotel, Chicago.

Apr. 3-8: Nuclear Congress, EJC, PGNS of IRE, New York Coliseum, New York City.

Apr. 11-13: Space Conference, Engineering Technology, AIEE, Baker Hotel, Dallas, Tex.

Apr. 11-14: Weather Radar Conference, American Meteorological Society and Stanford Research Institute, San Francisco.

Apr. 12-13: Protective Relay Engineers, Annual, A&M College of Texas, College Station, Texas.

Apr. 12-13: Electronic Data Processing, ARS, Hotel Alms, Cincinnati, O.

Apr. 12-13: Static Relay Symposium, USA Signal R&D Lab, Hexagon Auditorium, Ft. Monmouth, N. J.

Apr. 18-19: Automatic Techniques, Annual Conf., ASME, IRE, AIEE, Cleveland-Sheraton Hotel, Cleveland.

Apr. 19-21: Active Networks & Feedback Systems, International Symposium, Department of Defense Research Agencies, IRE, Engineering Societies Bldg., N. Y. C.

Aug. 23-26: Western Electronic Show and Convention, WESCON, Ambassador Hotel & Memorial Sports Arena, Los Angeles.

Oct. 10-12: National Electronics Conf., Hotel Sherman, Chicago.

There's more news in ON the MARKET, PLANTS and PEOPLE and other departments beginning on p 196.

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Electron Tube News ...from SYLVANIA

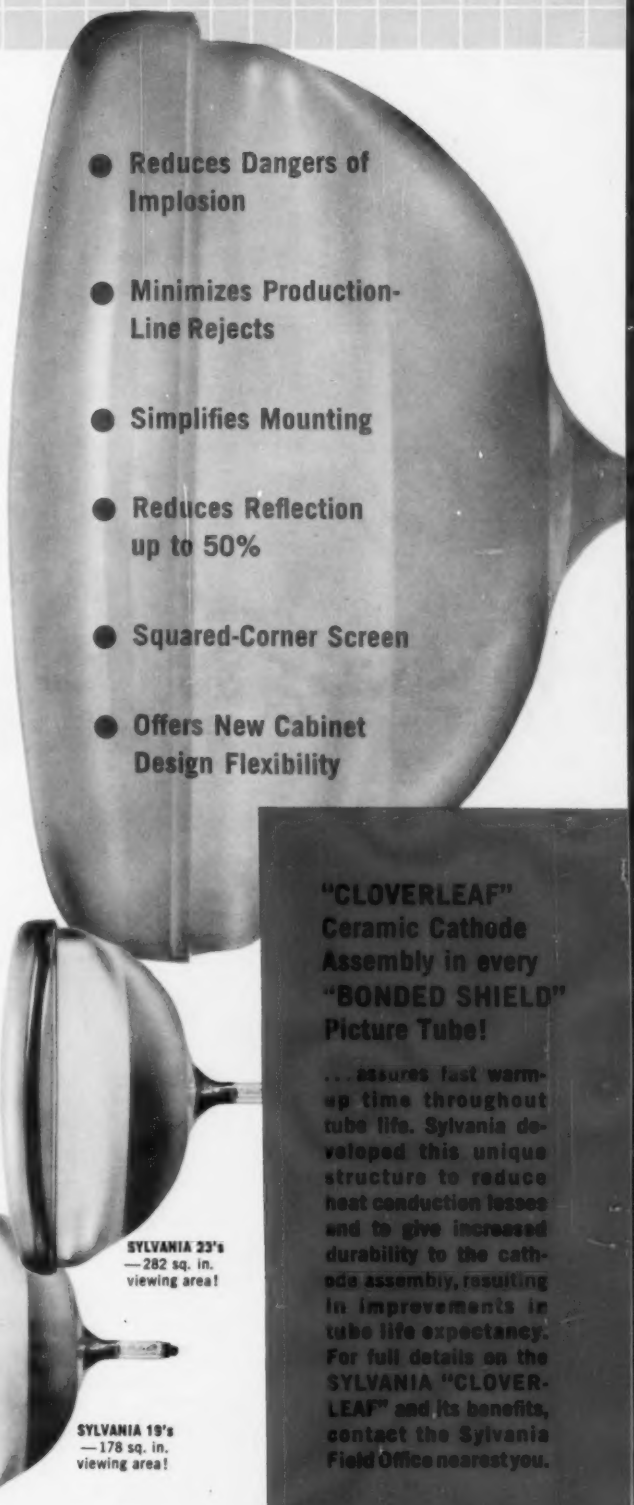
TV PICTURE IS "UP FRONT" ...SALES ARE, TOO

...when you design around Sylvania 23" and 19" "Bonded Shield" TV picture tubes!

SYLVANIA pioneered the techniques that make possible the quantity production of the new "Bonded Shield" picture tubes for TV sets. SYLVANIA led the way by making "Bonded Shield" picture tubes available to TV set manufacturers in commercial quantities. SYLVANIA was first to demonstrate how "Bonded Shield" eliminates the "picture-in-a-tunnel" effects; first to demonstrate the possibilities of "broad-angle viewing" dramatically offered by this new design.

An annealed-glass scratch-resistant cap is laminated to the face of the tube. It completely eliminates the need for a front-of-the-cabinet safety glass. This reduces reflections that interfere with the brilliance and clarity of the TV picture. Further, it reduces basic requirements for front-to-back dimensions of the TV cabinet, creating new possibilities for cabinet styling and sales appeal. The laminated safety cap eliminates the dust trap between tube face and safety glass. Corners are squared to give larger picture areas. Integral safety-glass and mounting lugs add up to potential savings in costs of cabinetry. Now, "Bonded Shield" picture tubes are also available with non-glare coating. They offer freedom from undesirable reflections and glare.

For technical data and further information, contact the Sylvania Field Office nearest you.



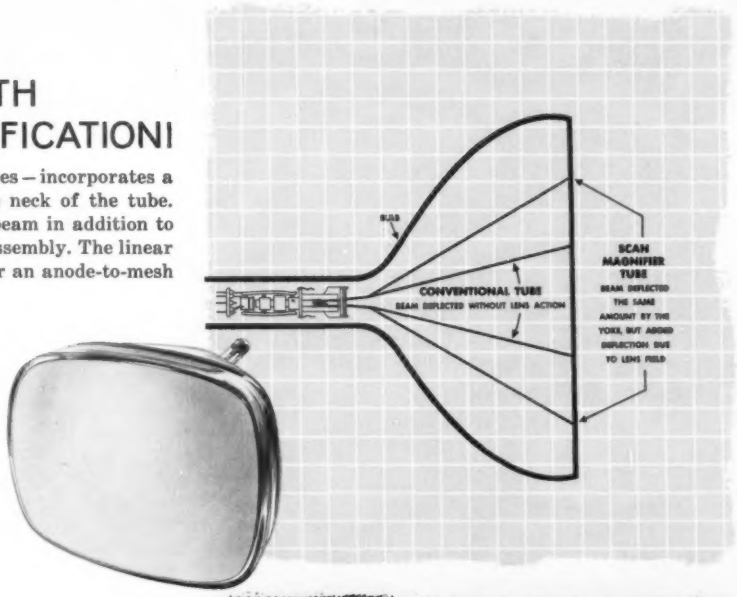
- Reduces Dangers of Implosion
- Minimizes Production-Line Rejects
- Simplifies Mounting
- Reduces Reflection up to 50%
- Squared-Corner Screen
- Offers New Cabinet Design Flexibility

"CLOVERLEAF" Ceramic Cathode Assembly in every "BONDED SHIELD" Picture Tube!

... assures fast warm-up time throughout tube life. Sylvania developed this unique structure to reduce heat conduction losses and to give increased durability to the cathode assembly, resulting in improvements in tube life expectancy. For full details on the SYLVANIA "CLOVERLEAF" and its benefits, contact the Sylvania Field Office nearest you.

NEW – PICTURE TUBES WITH ELECTRONIC SCAN-MAGNIFICATION!

SYLVANIA ST-2836A – now in the developmental stages – incorporates a mesh-like diverging-lens assembly positioned in the neck of the tube. Its function is to provide deflection of the electron beam in addition to that accomplished by the magnetic field of the yoke assembly. The linear magnification of scan is in the order of two times for an anode-to-mesh voltage ratio of 2 to 1. The primary benefit of such a technique is in the reduction of horizontal-deflection power requirements. It is anticipated that this power requirement may be reduced in practice to as much as 60% of that required for conventional 110° picture tubes. Engineering samples with *low-power heaters* (1.5-volts @ 140 ma., or 12.6-volts @ 150 ma.) and/or low Eg_2 characteristics for a *complete* low-power picture tube are also available. For technical data and further information on SYLVANIA experimental-design SCAN-MAGNIFIED PICTURE TUBES, contact the Sylvania Field Office nearest you.


CONVENTIONAL TUBE
BEAM DEFLECTED WITHOUT LENS ACTION
SCAN MAGNIFIER TUBE
BEAM DEFLECTED THE SAME AMOUNT BY THE YOKE, BUT ADDED DEFLECTION DUE TO LENS FIELD

NEW – HIGH-VISIBILITY 'SCOPE TUBE FOR AIRBORNE WEATHER RADAR!

SYLVANIA SC-2854 provides improved image brilliance under wide ambient light conditions encountered in cockpits of commercial airliners. The color of the phosphor of this new tube gives exceptional image visibility to dark-adapted as well as to light-adapted eyes. Resolution, too, is exceptionally high. *Sylvania SC-2854* makes possible simplified equipment designs, improved volumetric efficiency and increased life-expectancy of the indicator tube, resulting in reduced costs of installation and maintenance of airborne weather-radar equipment. For details on price and delivery, contact your Sylvania Field Office.

NEW – C.R.T.'S FOR HIGH-ALTITUDE OPERATION TO 70,000 FEET!

Sylvania now makes available a group of direct-view cathode-ray tubes designed specifically for applications in airborne ECM, Radar, and Loran equipment intended for operation at high altitudes. All types feature high quality, nearly flat pressed-glass faceplates. This provides exceptionally clear display and excellent bulb strength. Connections to internal elements are made through insulated leads, encapsulated at points of entry to the bulb. This technique significantly reduces the possibility of corona and arc-over at high altitudes. See data below.

SYLVANIA 5CVP1, 5CVP7, 5CVP19 . . . feature 2¾" x 4¾" direct-view faces, magnetic deflection, electrostatic focus.

MAXIMUM RATINGS (Absolute Maximum Values)

Anode Voltage	4500 Volts dc
Anode Input	6 Watts
Grid No. 4 Voltage (Focusing Electrode)	−500 to +1100 Volts dc
Grid No. 2 Voltage	550 Volts dc
Grid No. 1 Voltage	
Negative Bias Value	165 Volts dc
Positive Bias Value	0 Volts dc
Positive Peak Value	2 Volts
Peak Heater-Cathode Voltage	
Heater Negative with Respect to Cathode	180 Volts
Heater Positive with Respect to Cathode	180 Volts
Altitude	70,000 Feet
Operating Temperature Range	−65 to +85°C

SYLVANIA 3BEP1, 3BEP-• . . . feature 1½" x 3" direct-view faces, electrostatic focus and electrostatic deflection. (-• can be supplied with several other screen phosphors.)

MAXIMUM RATINGS (Absolute Maximum Values)

Anode No. 2 Voltage	3000 Volts dc
Anode No. 1 Voltage (Focusing Electrode)	1200 Volts dc
Grid No. 1 Voltage	
Negative Bias Value	140 Volts dc
Positive Bias Value	0 Volts dc
Positive Peak Value	2 Volts
Peak Heater-Cathode Voltage	
Heater Negative with Respect to Cathode	140 Volts
Heater Positive with Respect to Cathode	140 Volts
Altitude	70,000 Feet
Operating Temperature Range	−65 to +85°C

SYLVANIA ANNOUNCES

3 NEW TUBE TYPES WITH 9-T9 OUTLINE!

New **17HC8, 6HC8** and **7695** offer important advantages inherent in the Sylvania unique 9-T9 design. Utilizing the straight-sided, 9-T9 bantam outline with its miniature 9-pin circle, these three types afford significant opportunities for compactness. The 9-T9 outline eliminates the octal base of the T9 and makes possible the use of tube structures capable of high plate dissipation in printed-circuit boards. This is accomplished with conventional 9-pin sockets widely used in printed circuits.

9-T9 increases volumetric efficiency of the chassis by eliminating the octal base of the T9 outline.

9-T9 enables the use of large tube-assemblies in those stages where higher power-dissipation capabilities of the tube are a design necessity to enhance reliability.

9-T9 maintains compactness of the equipment formerly afforded by tubes fitted with T6-½ header.

Sylvania 17HC8 is a triode-pentode designed for use as a vertical deflection oscillator and vertical deflection amplifier in 110° deflection circuits of TV receivers. Controlled for heater warm-up time, it is especially useful in 450mA series string operation. The pentode section has a plate dissipation of 11 watts. Structure of the 17HC8 includes an internal shield to reduce interaction of the elements. The 6HC8 is identical to the 17HC8 except for heater power requirements. In addition to normal 100% tests for shorts, continuity, plate current, gas, pentode screen current, heater cathode leakage, gm and triode cutoff, both types are tested 100% for peak plate and screen current, ratio of peak plate current to screen current, and microphonics.

Sylvania 7695, beam power pentode, features remarkably high power sensitivity as an audio frequency amplifier. In Class A1 operation, it can deliver 4.5 watts of power with a B+ voltage of only 130 volts. As a result, the 7695 makes possible economies in power supply requirements.

SYLVANIA 7695—Characteristics and Typical Operation

Class A1 Amplifier	Fixed Bias	Self Bias
Plate Voltage	130 Volts	140 Volts
Grid No. 2 Voltage	130 Volts	140 Volts
Grid No. 1 Voltage	−11 Volts	—
Cathode Resistor	—	100 Ohms
Peak AF Grid No. 1 Voltage (RMS)	11 Volts	8 Volts
Zero Signal Plate Current	95 mA	100 mA
Max. Signal Plate Current	100 mA	100 mA
Zero Signal Grid No. 2 Current	5 mA	5 mA
Max. Signal Grid No. 2 Current	13 mA	14 mA
Transconductance	11,000 μmhos	11,400 μmhos
Plate Resistance (approx.)	6,900 Ohms	6,800 Ohms
Load Resistance	1,100 Ohms	1,100 Ohms
Max. Signal Power Output	4.5	4.5
Total Harmonic Distortion (approx.)	11 Percent	11 Percent

NEW HI-FI TYPE

SYLVANIA 7687

CONTROLLED FOR LOW HUM

The new 7687 is a 9-pin miniature triode-pentode controlled for hum, noise and microphonics. It's a hard worker in tone-control amplifiers, phase splitter and high-gain voltage amplifier circuits, yet it does its job without even "breathing audibly." Sylvania 7687 structure is rigidly mounted to reduce noise and microphonic effects. It features a cooler-operating cathode to assure low hum. Further assurance of low hum is provided by the use of a coil heater made of specially developed materials. The triode section has an equivalent hum and noise level of 7.5 microvolts, the pentode only 10.5 microvolts. Investigate the possibilities of a cooler-operating tube with unusually low hum and long life expectancy for your compact high-fidelity design. The Sylvania 7687 merits your interest.

SYLVANIA "GLEAM" PROJECT COMBATS TUBE CONTAMINANTS, INCREASES TUBE RELIABILITY

Project "Gleam" further increases Sylvania tube reliability by eliminating lint and dust particles in factory operations. Fifteen years ago, Sylvania took its first air-purification measures to reduce contaminants that can result in early-hour tube failure. "Gleam" has gained impetus until it now includes the use of air conditioning in factories, lint-free clothing, individual hooded work-tables, enclosed cloakrooms, methanol welding to eliminate splash particles, lint-free parts-containers, and specially processed getter material which resists flaking and spattering. Like many technological advancements, the "Gleam" Project will never be wholly complete. It is constantly undergoing change and improvement to maintain the Sylvania name for unsurpassed quality.

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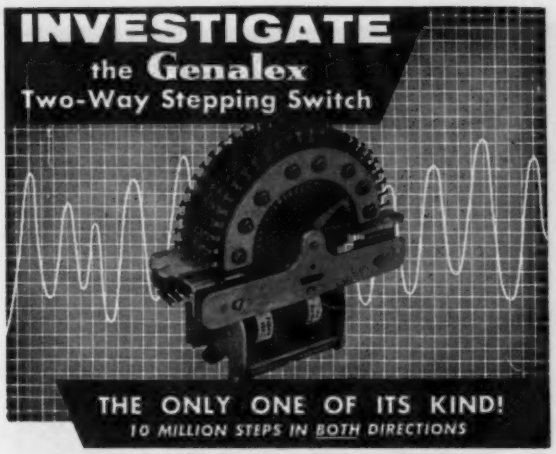

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For aircraft and missile applications—where solderjoint reliability is a precious must—General Electric's new Resistance Soldering Tool provides the void-free solderjoints necessary for reliable, high-quality connections.

This new tool is particularly useful for soldering multiple-prong plugs. It heats work evenly throughout, allowing complete solder melting in only one operation. Call your nearby G-E Apparatus Sales Office or write for Bulletin GEA-6588, General Electric Company, Schenectady 5, N. Y. 758-1

See the complete line of G-E Soldering Irons at the IRE Show, Booth 2932.

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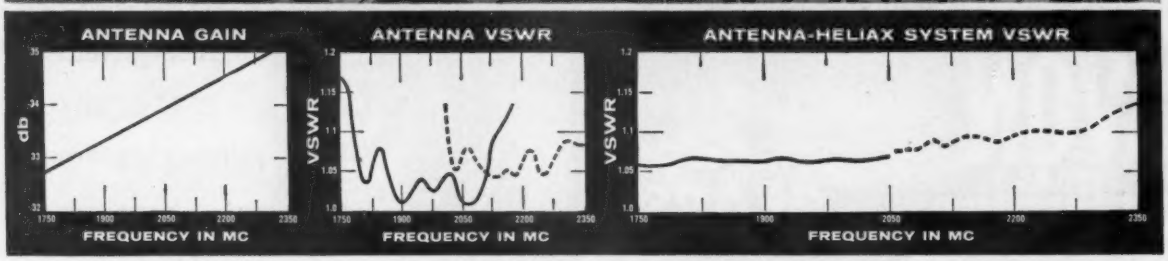

Antenna performance based on 60% gain factor

High and low band antenna VSWR plots of production test samples

Test results of high and low band production antennas and 110 feet of 7/8 inch HELIAX cable

A 600-channel microwave system to carry vital defence data was recently developed by Canadian-Marconi Company for the Royal Canadian Air Force. Because of its strategic value, this long haul line-of-sight system demanded reliable performance in the antenna equipment.

ANDREW Antenna Corporation, Ltd. is proud to have been chosen to design and produce this equipment to meet specific system requirements.

ANDREW microwave antenna, Type 21362, designed for this 1790-2260 mc system guaranteed a VSWR under 1.1. Minimum antenna gain of 33 db resulted from production models having gain factors of better than 60%. The antenna characteristics were sustained in the system through the use of ANDREW HELIAX, the flexible air dielectric cable. HELIAX was chosen for its low VSWR and attenuation, ease of handling and mechanical stability.

Automatic pressurizing equipment to regulate the dry air supply for this RF system was provided with an ANDREW Type 1910 dehydrator.

This is just one of many ANDREW antenna system installations in Canada that are consistently giving optimum performance in UHF/VHF and microwave frequencies. To get all the facts on ANDREW antenna systems, write or call today, giving your specific requirements.

We are anxious to supply U.S. Defence Contractors with Andrew antenna and transmission line items from Canada. Such purchases are duty-free, under the new, production sharing program.

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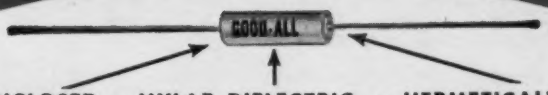

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Full Rated to 85°C

Types **626G - 627G** (Extended foil)
Types **628G - 629G** (Inserted tab)

Temperature Range—Full rating at 85°C — to 125°C with 50% derating.
Life Test—500 hours at 85°C and 125% of rated voltage.
Capacity Tolerance—All tolerances to ± 1%.
Insulation Resistance—40,000 meg. x mfd. at 25°C but need not exceed 70,000 megohms.
Case Styles—Available in all case style variations in MIL-C-25A.

Full rated to 125°C

Type **616G** (Extended foil)
Type **617G** (Extended foil)

Temperature Range—Full rating to 125°C - to 150°C with 50% derating.
Life Test—500 hours at 125°C and 125% of rated voltage.
Capacity Tolerance—All tolerances to ± 1%.
Insulation Resistance—50,000 meg. x mfd. at 25°C but need not exceed 100,000 megohms.
Case Styles—Available in all case style variations in MIL-C-25A.

50-VOLT DIMENSIONS

Capacitance in Mfds.	626G* D	626G* L	627G D	627G L	628G* D	628G* L	629G D	629G L	616G*† D	616G*† L	617G† D	617G† L
.001	.173	25/32	.173	25/32	.173	5/8	.173	5/8	.173	11/16	.173	5/8
.0022	.173	25/32	.173	25/32	.173	5/8	.173	5/8	.173	11/16	.173	5/8
.0047	.173	25/32	.173	25/32	.173	5/8	.173	5/8	.193	11/16	.193	5/8
.01	.173	25/32	.173	25/32	.173	5/8	.173	5/8	.193	11/16	.193	5/8
.022	.233	25/32	.233	25/32	.193	25/32	.193	25/32	.233	5/8	.233	15/16
.047	.312	25/32	.312	25/32	.233	25/32	.233	25/32	.312	11/16	.312	5/8
.1	.312	25/32	.312	25/32	.312	25/32	.312	25/32	.400	3/4	.400	7/8
.22	.400	1	.400	1 1/16	.400	7/8	.400	15/16	.500	1	.500	1 1/4
.47	.500	1 1/8	.500	1 3/16	.500	1	.500	1 1/4	.562	1 1/8	.562	1 1/4
1.0	.560	1 15/16	.560	1 15/16	.560	1 15/16	.560	1 15/16	—	—	—	—

*These types have one lead grounded to the case. Others have both leads insulated.

†Also available in 150V, 400V & 600V ranges.

Capacitance Change vs. Temperature

Insulation Resistance vs. Temperature

Write for literature on these new types.

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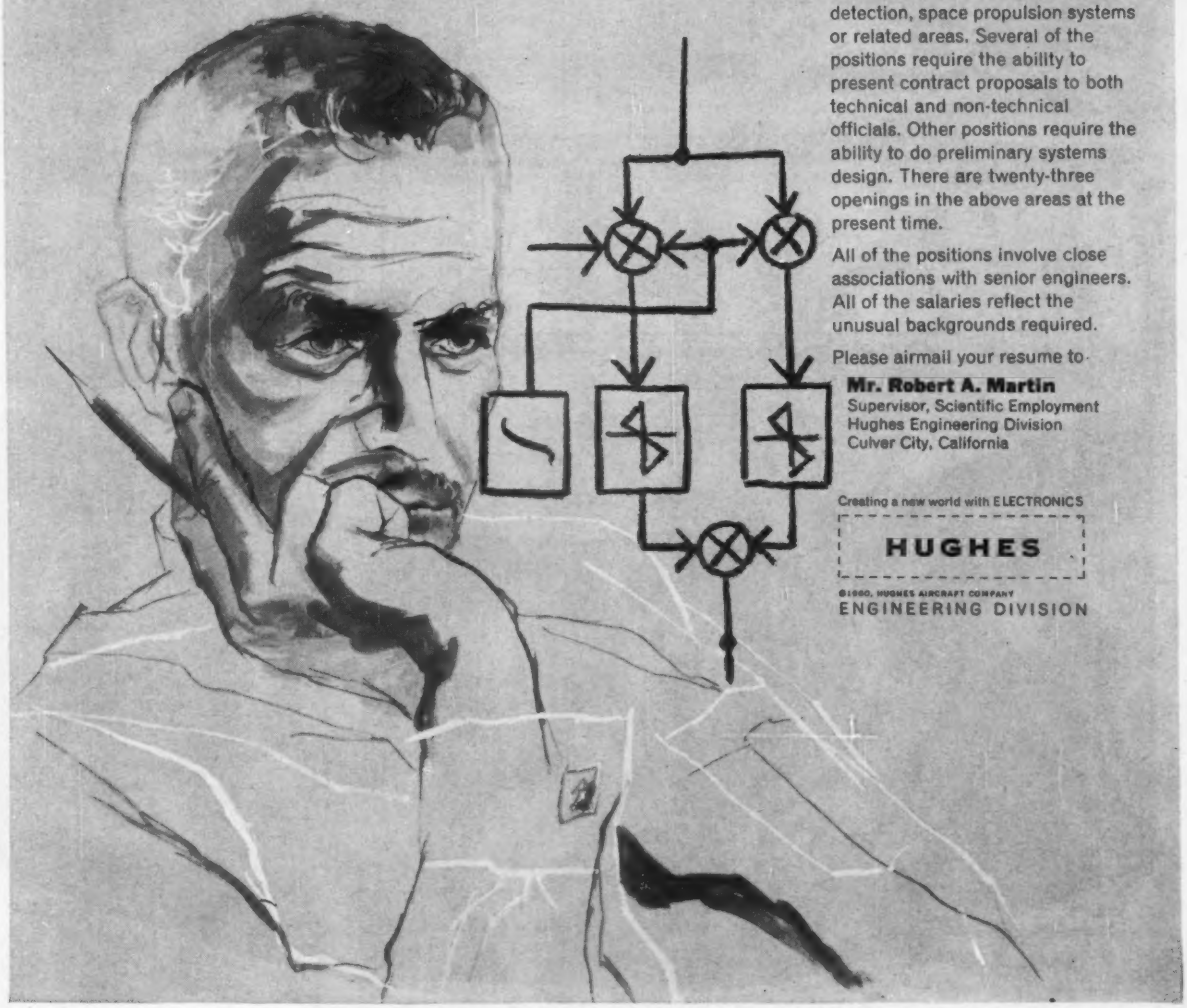

detection, space propulsion systems or related areas. Several of the positions require the ability to present contract proposals to both technical and non-technical officials. Other positions require the ability to do preliminary systems design. There are twenty-three openings in the above areas at the present time.

All of the positions involve close associations with senior engineers. All of the salaries reflect the unusual backgrounds required.

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Mr. Robert A. Martin
Supervisor, Scientific Employment
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RATIOMETER: Proved .003% attenuator accuracy for wide-range precision

SCANNING SYSTEMS: Proved reliability over weeks of automated transistor sampling

PRINTER CONTROL: Proved performance in data recording with every quality printer on the market.

. . . And the human-engineered Talking Meter,
for a vocal readout in any parameter.

When you're at New York IRE, stop by Cubic's booth and see the unique Weather Board monitored by a Cubic Digital System to give you the weather story across the nation . . . in digital and vocal report.

BOOTH 3235

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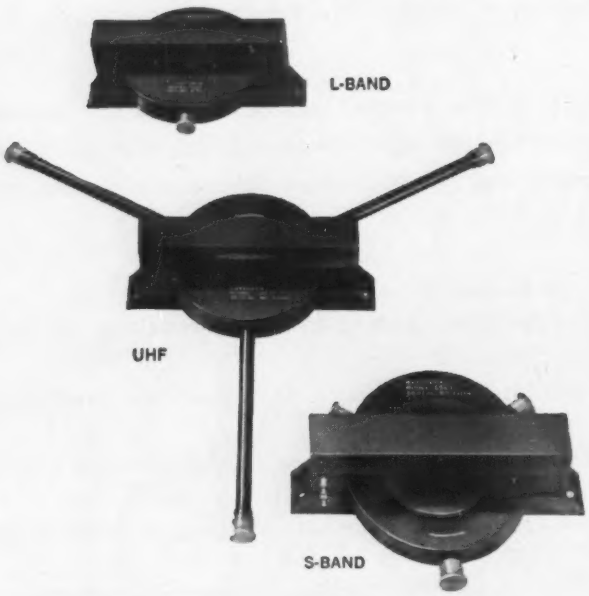
Electronic Engineering — With a Dimension for the Future

Years-ahead engineering, factory production techniques inspired by pride in the end result, careful quality control and reliability testing . . . all these factors make Cubic's the truly fine instrumentation . . . Digital Systems that speak for themselves.

CIRCLE 75 ON READER SERVICE CARD

RECENT RAYTHEON DEVELOPMENTS IN MICROWAVE FERRITE DEVICES

NEW 3-PORT CIRCULATORS FOR MASERS, PARAMETRIC AMPLIFIERS & RADIO ASTRONOMY



TWENTY EIGHT MODELS OF SMALL LOW-LOSS CIRCULATORS FOR L, S, AND UHF BANDS DOWN TO 350 MC

The unusually compact, low-loss, Raytheon circulator design first introduced for L-band applications last summer is now available in *28 standard models.*

The three-port circulators, designed for use with coaxial line, are supplied with fixed permanent magnets or with tunable electromagnets for operation over a broader band. Insertion loss is typically .4 db maximum.† Isolation on all units is 20 db minimum. VSWR is 1.25 maximum. See typical specifications at left.

To learn more about these significant developments or for information about other important Raytheon advances in microwave ferrite devices, please write, stating your particular area of interest, to the address below.

†L&S bands only. UHF insertion loss is typically .5 db.

TYPICAL SPECIFICATIONS

		L & S bands	
	UHF	Tunable units	Fixed units
Frequency range	any freq. from 350-800	any freq. from 800-3000	any freq. from 800-3000
Bandwidth	±5 mc	±50 mc above 1000 mc ±40 mc under 1000 mc	±25 mc above 1000 mc ±20 mc under 1000 mc
Isolation	20 db min. 25 db max.	20 db min. 30 db max.	20 db min. 30 db max.
Insertion loss	.4 db min. .6 db max.	.3 db min. .4 db max.	.3 db min. .4 db max.
VSWR	1.08 min. 1.25 max.	1.08 min. 1.25 max.	1.08 min. 1.25 max.
Power (av.)	5 watts	5 watts	5 watts
Power (peak)	5 kw*	5 kw*	5 kw*
Wt. (max.)	10.0 lbs.	10.0 lbs.	9.0 lbs.
Max. diam.	7½ in. excluding arms	7½ in.	7½ in.

*With type N connector. Powers as high as 90 kw are possible with type HN connector.

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SPECIAL MICROWAVE DEVICES OPERATIONS
WALTHAM 54, MASSACHUSETTS

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Here are some of the 27 Marconi instruments you should see!

MARCONI INSTRUMENTS

for Electronic Measurement

VHF ADMITTANCE BRIDGE MODEL 978

- Frequency range : 30 to 300 MC
- Measures conductance : 0 to 50 millimhos, ±2% ± 0.1
- Measures capacitance : −40 to +40 μμf, ±2% ± 0.5
  (inductance measured as negative capacitance)
- Features high-stability servo-controlled conductance balance system

This simple, easy-to-use instrument is a general-purpose VHF bridge particularly suitable for measurements on unbalanced antenna systems, coaxial transmission lines, and distributed components in general, as well as on a wide range of lumped components. Operating in the range 30 to 300 MC, it fills the gap between slotted lines and conventional RF bridges. It is arranged for use with an external oscillator and detector, both of which can be supplied as optional accessories ; alternatively a conventional VHF signal generator and receiver may be used.

FM SIGNAL GENERATOR Model 1066A

Frequency Range : 10 to 470 MC, on fundamentals throughout. 0.0025% short-term stability.

Direct-Reading Incremental Tuning : Stepped control up to ±15 kc; continuously variable from 0 to ±20 and 0 to ±100 kc.

Output Range : 0.2 μv to 200 mv at 50 ohms.

Modulation : FM deviation continuously variable and monitored from 0 to 20 and 0 to 100 kc. Also AM up to 40%. Modulation frequencies, 1 and 5 kc. Rack mounting version, Model 1066A/1, now available.

CARRIER DEVIATION METER Model 791D

Measures Deviation : 200 cps to 125 kc in four ranges ; extended down to 10 cps using external readout.

Carrier Frequency Range : 4 to 1,024 MC, directly calibrated.

Modulation Frequency Range : 50 cps to 35 kc.

Crystal Locking : ensures freedom from microphony, allows measurement of FM hum and noise in VHF and UHF communication and broadcast transmitters.

Model 791D can be supplied for rack mounting.

at the IRE SHOW

BOOTHS 3301-03-05

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FIELD STRENGTH METERS
TRANSMISSION MONITORS
DEVIATION METERS · OSCILLOSCOPES
SPECTRUM & RESPONSE ANALYZERS
Q METERS & BRIDGES

TEST SETS FOR MOBILE RADIO

SIGNAL GENERATOR Model 1064A/2 and TRANSMITTER AND RECEIVER OUTPUT TEST SET Model 1065. Self-contained portable instruments for field testing mobile transreceiver sets. Signal Generator 1064A/2 provides RF outputs of 30 to 50, 118 to 185, and 450 to 470 MC, with FM deviation at 10 kc fixed and 0-15 kc variable; IF crystal outputs at five spot frequencies, and also an AF output. Test Set 1065 comprises an RF power meter and deviation indicator for use up to 500 MC, a dual-impedance AF power meter, and a multi-range voltammeter.

Model 1064A/2 above

Q METER Model 1245

Frequency Range: 1 kc to 300 MC. Measures Q: 5 to 1,000: accuracy 5% at 100 MC. **Q Multiplier :** ×0.9 to ×2. **Delta Q:** 25-0-25. **Test Circuits:** separate LF and HF test circuits have ranges of 1 kc to 50 MC and 20 to 300 MC. **Capacitance Range:** 7.5 to 110 $\mu\mu$f with 1-0-1 $\mu\mu$f incremental, for either test circuit: 20 to 500 $\mu\mu$f for LF test circuit. **Shunt Loss:** 12MΩ at 1 MC, 0.3 MΩ at 100 MC. **External Oscillators :** Model 1247, 20 to 300 MC. Model 1246, 40 kc to 50 MC, Model 1101, 20 cps to 200 kc.

Model 1247

Model 1245

MARCONI INSTRUMENTS

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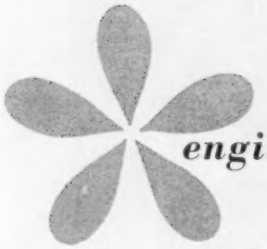
TC168



engineers scientists

how can you measure the progress of a company?

Progress doesn't just happen. It's nourished—by research and development. The better the research resources, the greater the progress.

Apply this measuring stick to Collins. Over 25% of Collins personnel are engaged in research and development. Accomplishments include significant advances in Single Sideband, transhorizon and microwave communication systems; space and missile electronics; high speed data transmission; aircraft communication, navigation, instrumentation and control systems. Collins was the first to develop a radio sextant, the first to bounce a radio message off the moon. Collins pioneered the development of airborne SSB equipment, and is currently producing military global communication systems.

Research and development doesn't just happen! It, too, must be nourished—by a constant stream of new ideas from creative engineers and scientists.

And Collins needs additional talented, career-minded engineers and scientists to sustain its rapid growth. You and your creative ideas could fill one of the many positions now open. Each offers unlimited opportunity for growth and advancement in your profession.

Projects are both varied and challenging

Cedar Rapids—E. E.'s and M. E.'s are needed for R & D in airborne communication, flight control, navigation and identification systems, gyro systems, missile and satellite tracking and communication, antenna design, amateur radio and AM broadcast. Basic research opportunities are open for scientists desiring to work in the fields of advanced circuits, solid state, antennas, propagation and advanced systems.

Dallas—E. E.'s and M. E.'s with 2—5 years microwave experience for R & D in microwave systems, radar, ECM, antenna design, solid state switching, and ground support test equipment.

Burbank—Experienced engineers are needed for R & D in high speed data transmission, test equipment design and reliability engineering.

Plan now to talk to a Collins representative at the IRE Show

IRE Show interviews — Collins will be interviewing in New York, Monday, March 21 through Thursday, March 24. For a personal, confidential interview, phone Mr. L. R. Nuss, PLaza 5-4580. A convenient appointment time will be arranged. If unable to interview at this time, send your resume to: Mr. L. R. Nuss, Collins Radio Company, Cedar Rapids, Iowa; Mr. Ben E. Jeffries, Collins Radio Company, 1930 Hi-Line Drive, Dallas 7, Texas; or Mr. F. W. Salyer, Collins Radio Company, 2700 W. Olive Ave., Burbank, California.

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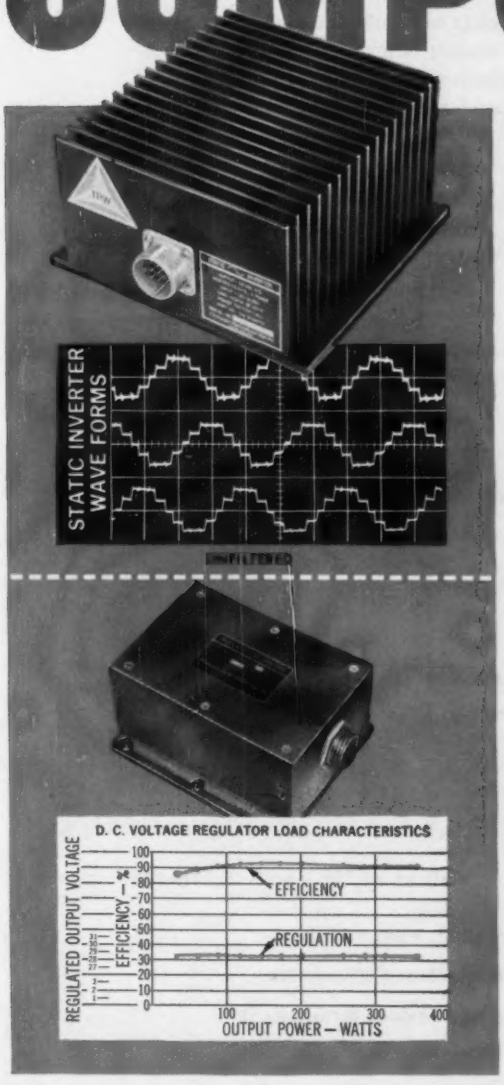
TAPCO ELECTRONIC COMPONENTS



STATIC INVERTER—The TAPCO inverter employs special logic and power circuitry which generates the three-phase output shown in the photograph at left. This technique of "synchronous switching"* provides an output which is essentially devoid of 3rd and 5th harmonics and their multiples as well as all even harmonics. Although the resultant wave form can be used unfiltered in many applications, a total harmonic distortion of less than 5% can be obtained with a filter that is appreciably smaller and lighter than would be required to filter a square wave. Special controlled rectifier output circuitry provides both efficient voltage regulation and short circuit protection. Switched mode operation throughout insures maximum efficiency as well as minimum size and weight. *Patent applied for

PERFORMANCE DATA – Input Voltage d.c.: 18-31 vdc. **Output Voltage 3-phase:** 115 vac ±1%, WYE or DELTA connected. **Output Power:** 500 VA. **Power Factor:** Unrestricted. **Output Frequency:** 400 cps ±0.02% standard ±0.0001% where required. **Distortion:** Less than 5%. **Maximum ambient at full load:** 125°C. **Wave Form:** Sine wave. **Short Circuit Protection:** Limits to 300% rated current. **Efficiency Full Load:** 85%. **ENVIRONMENTAL DATA Vibration:** 10g through 3000 cps. **Shock:** 40g. **Acceleration:** 12g for 5 minutes. **Temperature:** −55°C to +125°C. **PHYSICAL DATA–Envelope Dimensions Including Fins:** 4.5" x 9" x 10". **Weight:** 25 lb.

VOLTAGE REGULATOR—This regulator utilizes a pair of silicon controlled rectifiers in a full-wave, buck-boost configuration. By means of a fast response magnetic amplifier, this circuit simultaneously provides efficient voltage regulation, transient elimination, and short circuit protection. A stable internal d.c. reference in conjunction with the magnetic amplifier provides the necessary control to maintain an output voltage constant to within ±0.7%. Efficiency of over 90% is obtained with d.c. input voltage variations as high as 22 to 30 vdc.

PERFORMANCE DATA–Voltage Regulation (Under worst combination of load, environment, input power): ±0.7%. **Input Voltage d.c.:** 22-30 vdc. **Output Voltage d.c.:** 28.3 ±0.7%. **Input Voltage a.c.:** 115v ±5%, 2000 cps ±1%. **Output Power:** 350 watts. **Output Ripple:** 15 mv peak to peak. **Efficiency Full Load:** 90%. **Transient Protection:** Will absorb up to 46 volts peak at the d.c. input terminals. **Short Circuit Protection:** Current limited to 300% rated current. **Output Impendance:** .02 ohms d.c., 2 ohms 10 cps to 40 kc. **ENVIRONMENTAL DATA–Vibration:** 10g through 3000 cps. **Shock:** 40g. **Acceleration:** 12g for 5 minutes. **Temperature:** −65°F to +165°F. **PHYSICAL DATA – Size:** 3" x 4" x 6". **Weight:** 5.3 lbs.

TAPCO GROUP, Dept. EL-300
Thompson Ramo Wooldridge Inc.
Cleveland 17, Ohio

Please send me a Product Data Folder on:
☐ Static Inverter ☐ Voltage Regulator

Name _____
Title _____
Company _____
Address _____

TAPCO GROUP
Thompson Ramo Wooldridge Inc.
CLEVELAND 17, OHIO

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LEADS THE INDUSTRY IN ULTRA-HIGH-POWER DUPLEXING

with both GAS DISCHARGE and FERRITE DUPLEXERS

Selecting a duplexer for high-power applications involves consideration of peak power, average power, transmit loss, receive loss, expected life, and versatility of operation.

All Microwave Associates high power gas duplexers utilize special window structures for optimum switching efficiency without sacrifice in low-level loss characteristics. These windows insure reliable, long-life performance. Both our gas and ferrite duplexers may be operated over very broad bandwidths at the common microwave frequencies.

Exceptionally complete ultra-high-power design and test equipment is utilized by our Research and Production Departments. Each duplexer is fully tested at maximum rated power before shipment.

We have extensive experience in designing and manufacturing high-power duplexer devices and are interested in working on newest ultra-high-power applications. We are now developing ultra-high-power duplexers for more efficient switching at UHF, L, C, and S bands.

Our Applications Engineers would like to discuss the future of high power duplexing with you.

Frequency Band	Duplexer Type	Peak Power	Average Power	Transmit Loss (max.)	*Receive Loss (max.)	Bandwidth
UHF	Gas	5 Mw	300 Kw	0.1 db	0.4 db	Tunable
	Gas	25 Mw	75 Kw	0.1 db	0.4 db	
L	Gas	25 Mw	50 Kw	0.1 db	0.5 db	
S	Gas	6 Mw	30 Kw	0.1 db	0.7 db	
	Ferrite	3 Mw	5 Kw	0.5 db	0.9 db	
C	Gas	5 Mw	5 Kw	0.1 db	0.7 db	
	Ferrite	5 Mw	7.5 Kw	0.3 db	0.8 db	10% Nominal
X	Gas	500 Kw	500 W	0.2 db	1.0 db	
	Ferrite	1 Mw	1 Kw	0.3 db	0.9 db	
Ku	Gas	150 Kw	150 W	0.2 db	1.0 db	
	Ferrite	150 Kw	150 W	0.3 db	0.9 db	
Ka	Ferrite	75 Kw	75 W	0.3 db	1.1 db	4% Nominal

All Microwave Associates duplexers incorporate low-loss, long-life, receiver protectors which guarantee crystal protection over wide temperature ranges and under extreme environmental conditions.

*The duplexer receiver loss includes the loss due to receiver protector TR tubes.

Visit us at IRE Booth 2301-2303

At each frequency band of the microwave spectrum, Microwave Associates has devices for efficient switching of high power.

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BURLINGTON, MASSACHUSETTS

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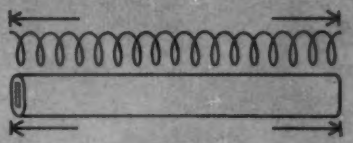
See us March 21-24 at the I.R.E. Show/Booths 1619-1621

BOURNS TRIMPOT® WITH BUILT-IN TEMPERATURE STABILITY

Stable settings under extreme temperature conditions is an outstanding feature of the Trimpot® potentiometer. This thermal stability is built-in through all phases of design and production—

MATCHED COEFFICIENTS OF THERMAL EXPANSION

Resistance wire and mandrels have matched coefficients of thermal expansion to reduce the "strain gage effect." Linear expansion rates for the mandrel and wire match so closely that the temperature coefficient value for the entire wirewound element approximates that of the wire itself.

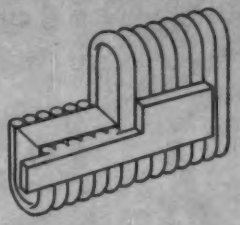


THERMALLY STABLE CERAMIC MANDRELS

Bourns takes advantage of high thermal stability of ceramic materials for element mandrels. Today, all Bourns Trimpot potentiometers provide the improved performance and reliability afforded by ceramic materials.

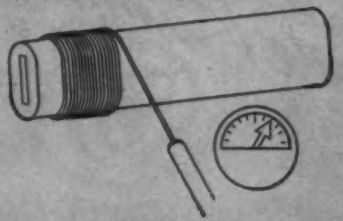
EXCLUSIVE SILVERWELD® TERMINATION

Silverweld is an actual metal-to-metal fusion of element wire and external terminal. In doing away with mechanical or soft-solder joints, Bourns eliminates potential hot spots thus extending the potentiometer's temperature range. The fusion of the Silverweld terminal to many turns of wire on the resistance element avoids the problem of single wire termination. Silverweld is virtually indestructible under thermal stresses.



EXCLUSIVE TENSION CONTROL EQUIPMENT

Bourns has developed specialized winding equipment that provides constant and precise control of wire tension during winding operations. "Necking" of the wire or resistance-altering stresses never occur. Instead the wire remains uniform—well able to withstand temperature variations with no appreciable change in resistance.



Specify Trimpot — the original leadscrew-actuated potentiometer with reliability on which you can depend. 20 basic models — 4 terminal types — 3 mounting styles.

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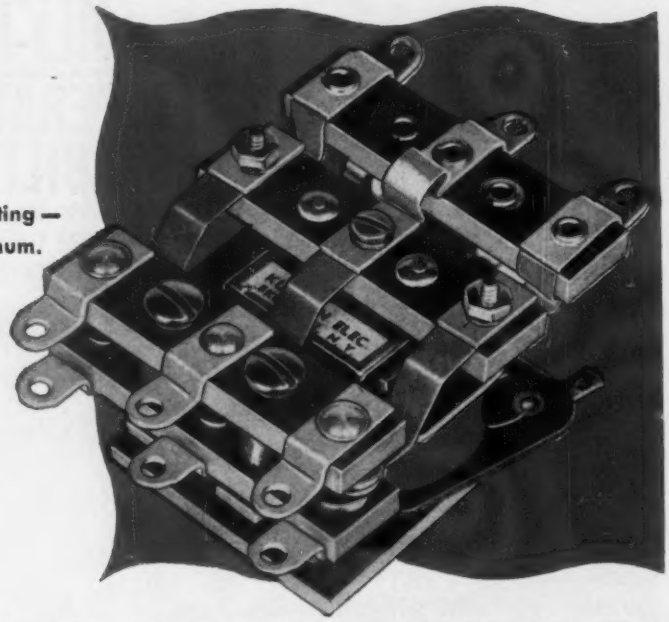
KURMAN

Series 26
Miniature Power Relays



Unique

*20 Ampere Per Pole Rating — 250,000 operations minimum.

Most Sensitive

*Requires only about ½ watt per pole

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High Speed Relay S.P.D.T., D.P.D.T., and T.P.D.T. 6V-110V, D.C. and 6V-230V, A.C.

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Available "OFF THE SHELF" in various combinations of voltage and contact arrangements including . . .

- . . . Plastic cover with octal plug-in (10 amp. per pole)
- . . . Hermetically sealed — octal plug-in and solder terminals
- . . . Heavy duty screw terminals (30 amperes per pole)

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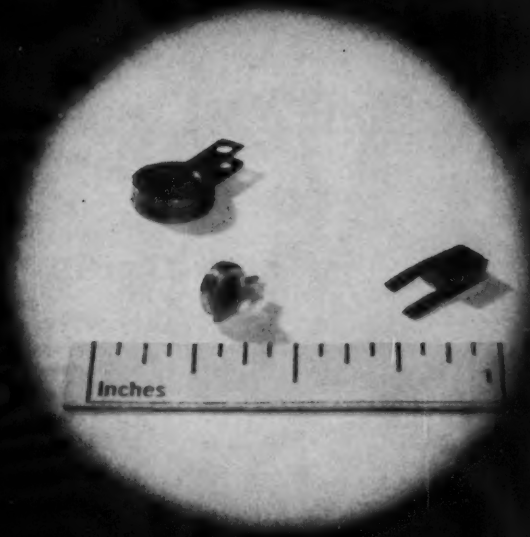

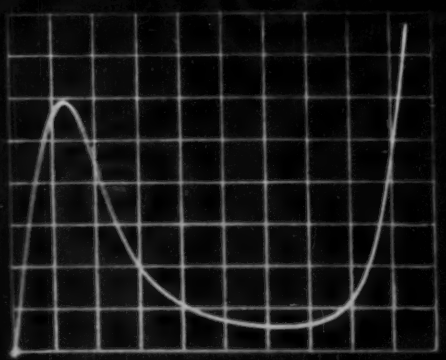

I. R. E. SHOW: BOOTH 2004

SONY CORPORATION

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Don't miss this special report at the IRE Show...

NEW DEVELOPMENTS IN HIGH-TEMPERATURE DIELECTRICS

A comprehensive lecture-demonstration by the engineering staff of Mycalex Corporation of America

Time—3:15 P.M. Daily

Place—FRANCE ROOM
Floor 2M, N.Y. Coliseum

Dates—March 21-24 *(Inclusive)*

Admission—By Invitation ONLY

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Just a few of the highlights featured at the Mycalex Corporation of America demonstration will include: applications, engineering problems and solutions in high-temperature dielectrics illustrated with special color slides showing:

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—complete with materials and component samples. This will be followed by a discussion period during which questions will be answered by the Mycalex engineering staff. For your personal invitation, register in advance at the Mycalex booth No. 2729-2731, 2nd Floor, IRE Show.

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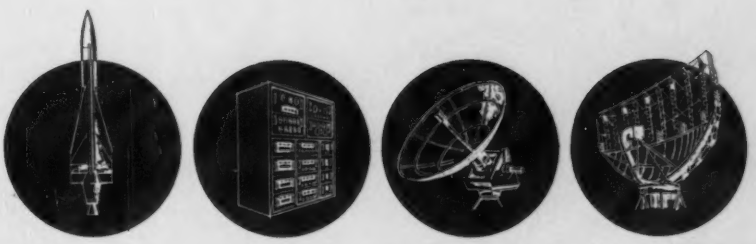
THE GUARANTEED ELECTRONIC COMPONENTS



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GOOD ELECTRONIC DESIGN

always starts with having the *correct* component for each circuit requirement. And when you select that component from the more than 4,000 CAMBION Guaranteed Electronic Components, you add the *better design factor . . .* reliability.

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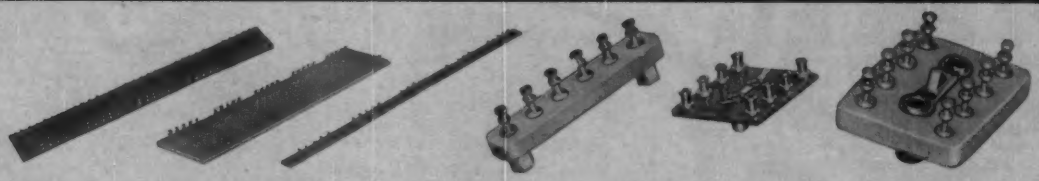
CAMBION's advanced engineering and

497 DIFFERENT TERMINALS IN 33 STYLES

Complete line of solder terminals for swage-mounting, thread-mounting, and press-mounting. Single, double, and triple-turrets. Feed-through, double-ended, hollow, and split types. Held to extremely close tolerances. Cross-section checks assure proper plating on all significant surfaces. CAMBION Swaging Tools assure fastest, most-efficient assembly.

Wide variety of insulated terminals in stand-off and feed-thru types with ceramic, Teflon*, or phenolic insulation. Teflon types press-mount. Also available with internal and external mounting threads, and as rivet types. All function over a broad humidity range. Voltage breakdown tests assure proper ratings.

*DU PONT REG. T.M.



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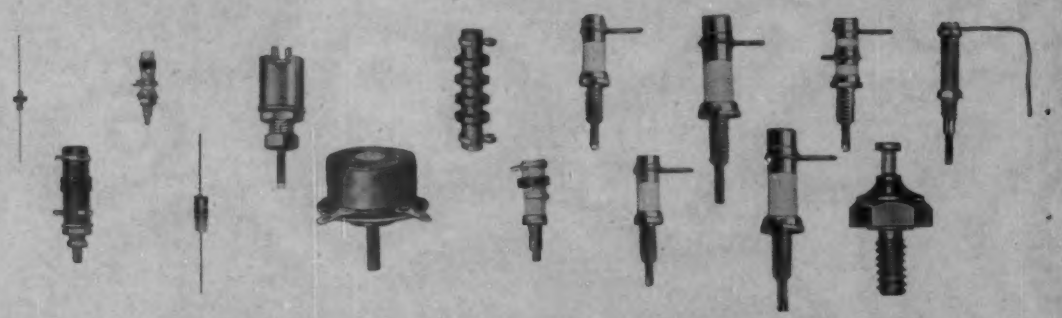
Compact, standard slug-tuned types . . . horizontal and vertical models with forms of ceramic, paper phenolic. A style to meet every requirement of printed and conventional circuits. Ceramic threaded-stud types available with Perma-Torq® positive-lock tuning. Shielded types in single- and double-tuned models. All types available wound to customer specifications. Kit containing 3 each of 5 popular types of CAMBION coil forms with silicone-fiberglas collars, Perma-Torq lock, and ring terminals.

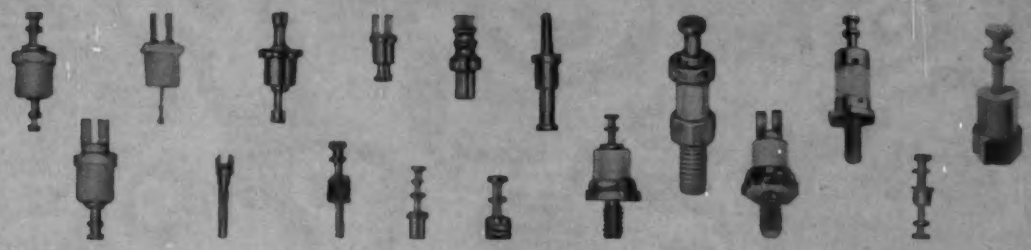


35 TYPES OF PLUGS AND JACKS

A diversified range of standard and miniature connectors for solder and crimping assembly in conventional and printed circuit work. All jacks have solid front compression spring and floating "D" key for positive connections and lasting, low-resistance contact. Insulated types with red, black, or natural nylon sleeves. Brass plated with bright alloy, nickel, or gold.

manufacturing facilities make that guarantee possible. Made from certified materials, all CAMBION Components are given rigorous electrical, mechanical, and environmental tests . . . carefully measured for dimensional accuracy. Under careful quality control methods *all the way*, they're superior products well qualified to meet today's demanding design requirements. For complete details write for Catalog W600, CAMBRIDGE THERMIONIC CORPORATION, 437 Concord Avenue, Cambridge 38, Massachusetts.

"Quality that Follows Through" from Prototype to Production



42 TERMINAL BOARDS IN 5 DIFFERENT MATERIALS

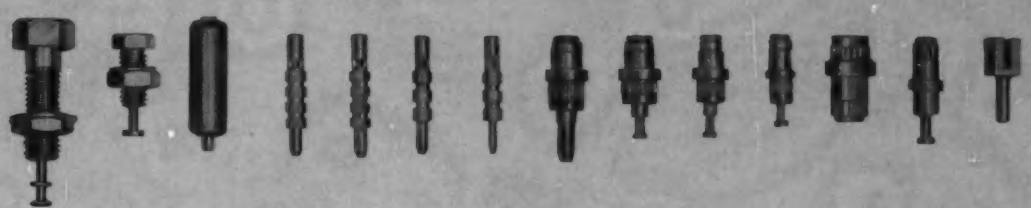
Standard all-set, miniature all-set, and custom-built models for conventional and miniature applications. Available in cotton-fabric phenolic, paper phenolic, glass epoxy, melamine glass, and ceramic. Scribed for convenient separation. Standard ceramic boards available in 6 sizes for high temperature applications.

32 COILS 43 CHOKES 9 CAPACITORS

A broad family of standard wound coils (regular and new shielded types) and chokes covering a wide range of inductances minimizes need for "specials." Rated in preferential values with color coding. Wound on ceramic, paper phenolic, or molded phenolic coil forms. All windings varnish impregnated. Studs on ceramic forms securely mounted by special CAMBION process. Ten-coil development kit available with overlapping inductance ranges from 2 μh to 800 μh.

Custom-wound types in any quantity are available to meet specific needs in printed and conventional circuits.

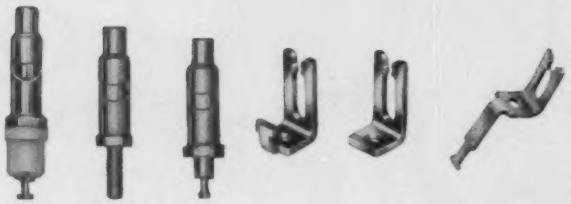
Subminiature capacitors with advanced design tuning that permits wide capacity ranges. Supplied complete with single mounting studs and lock for tuning element. Fixed stand-off types also available with capacity elements epoxy-embedded for maximum resistance to moisture.

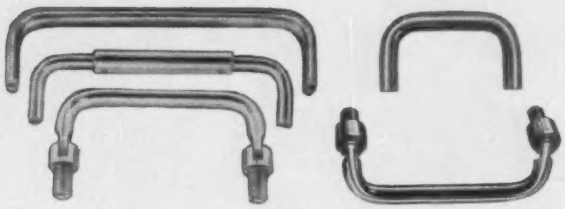


Battery Holders
Binding Posts
Brackets
Bushings
Capacitors
Chokes
Coils
Coil Forms
Dial Locks
Diode Clips
Ferrules
Handles
Hardware
Insulated Terminals
Jacks and Plugs
Kits
Knobs
Terminals
Terminal Boards
Tube Clamps

39 DIFFERENT DIODE CLIPS

Spring-loaded and spade types. Positive-gripping clips with a wide range of applications for component mounting in conventional and printed circuits. Screw-stud or rivet-mounted types. Teflon® type for press-mounting. Stand-off or feed through design. Spring-loaded types take wire from .069" to .085" diameter. Spade types take pins from .005" to .080" diameter.



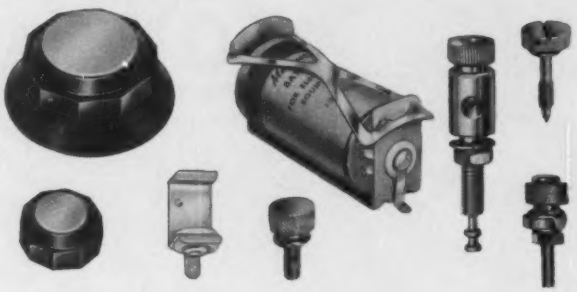


HANDLES IN 36 TYPE-AND-FINISH COMBINATIONS

Fixed, full-folding, and 90° folding types. Adjustable (telescoping) and oval types. Stainless steel and aluminum. Brass, plated as specified. Handles buffed before plating for long lasting, high luster. Custom made handles on request. Special packaging gives positive protection until used . . . you start with a perfect finish.

KNOBS . . . BATTERY HOLDERS . . . HARDWARE

Guaranteed quality too in the vital panel "sundries." Kollet knobs, molded from Tenite II with black satin finish. Snap-in caps available in 9 coded colors. With or without skirts. Arrow in skirt is optional. Mercury battery holders for 1 to 5 cells . . . with positive locking device. Also a complete line of binding posts, thumb screws, brackets and stand-offs.



ALL COMPONENTS MEET OR SURPASS THESE GOVERNMENT SPECIFICATIONS

MATERIALS

Aluminum	QQ-A-365a Comp A, T3; QQ-A-268, T4
Beryllium-Copper	QQ-C-530
Brass	QQ-B-626a, Comp 22, ½ Hard
Ceramic	JAN-I-10, Grade L-5
Glass-Cloth, Epoxy-GEE	MIL-P-18177B
Glass-Cloth, Melamine-GMG	MIL-P-15037B
Glass-Cloth, Silicone — GSG	MIL-P-997B
Nylon 101	MIL-P-17091B, Type II
Phenolic, Cotton-Fabric — FBE	MIL-P-15035B
Phenolic, Nylon-Fabric — NPG	MIL-P-15047B
Phenolic, Paper-Base — PBE, PBG	MIL-P-3115B
Phosphor Bronze	QQ-P-330, Grade A, Spring Temper
Steel, Cold Rolled	QQ-S-633b, Grade FS-1010
Steel, Stainless	QQ-S-763b, Class 7, Type A
Wire, Copper	MIL-W-583A
Wire, Stainless Steel	QQ-W-423, Comp FS-302

FINISHES

Alumlite	MIL-F-14072
Anodized	MIL-A-8625A
Black Oxide	MIL-F-495A
Cadmium	QQ-P-416a, Type II (Clear Chromate), Class B
Electro-Tin	MIL-T-10727, Type II

COMPONENTS

Capacitors, Fixed, Ceramic Dielectric	MIL-C-11015A
Coils, RF	MIL-C-15305A

PLATINGS

Gold	MIL-G-14548
Nickel	QQ-N-290, Type VI
Silver	46P5 (Ord), MIL-F-14072, QQ-S-365
Tin-Lead Solder	MIL-F-14072
Varnish	MIL-V-173A

GENERAL

Environmental	MIL-E-5272
Sampling	MIL-STD-105B
Test	MIL-STD-202A
Treatment	MIL-T-152
Control	MIL-E-5400A

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Regardless of the frequency in which you are working, there is a complete set of Microline impedance measuring instruments available.

Each instrument has been thoughtfully designed with accuracy and ease of operation in mind. The slotted line represents the ultimate in accuracy . . . the probe was designed for convenience . . . and the 29A1 includes the finest proven features of SWR Indicators.

The instruments of this complete line are perfectly coordinated to work with each other; however, they may be used separately with other units.

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Slotted Lines	21S1	$450
	21L1	(special order)
Probe	21B1	$125
SWR Indicator	29A1	$200

*To be used with Universal Carriage 21A1

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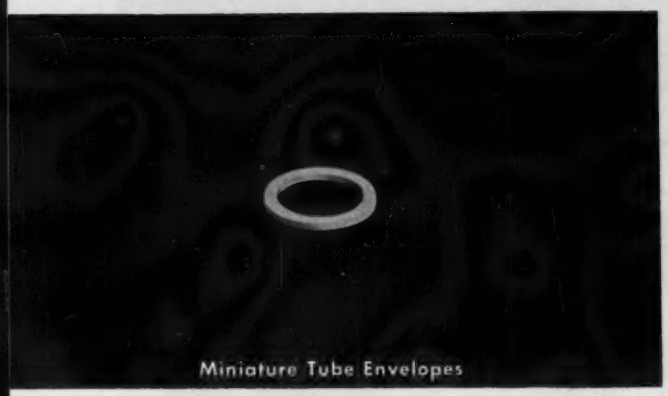
Precision Is The Standard At Coors

Ceramic Wafers for Micro-Modules

Micro-Module Wafers

The hottest news in extreme miniaturization of electronic equipment is the micro-module—an amazingly small combination of sub-miniature electronic circuit components. The fundamental unit of a micro-module is the high alumina ceramic base plate—a tiny ceramic wafer, approximately 0.300" square x 0.010" thick. Upon this is deposited or metalized a component of a circuit—a resistor, capacitor, transistor, diode, etc. The micro-module is a combination of several of these elements in a small space to serve a specific circuit function—amplifier, oscillator, etc.

Coors is manufacturing these precision wafers in large quantity production runs for several manufacturers working on the same project. Coors holds all dimensions of the tiny ceramic wafer to extremely close tolerances so that the micro-elements produced from them are entirely interchangeable from manufacturer to manufacturer .



Miniature Tube Envelopes

Tube Envelopes

Coors makes high strength ceramic envelopes to extremely close dimensional tolerances and in a wide range of sizes for use in modern electron tubes. Certain of the Coors ceramic compositions were developed specifically to meet the rigorous operating conditions and reliability requirements to which high power, high frequency tubes are subjected.

Illustrated here is one of the miniature ceramic envelopes in regular production. Coors regularly produces many other sizes up to 10" O.D. Larger sizes can be manufactured.

Coors ceramics have outstanding electrical and physical characteristics. These properties are not affected by high outgassing or high operating temperatures.

Ceramic-to-Metal Standard Terminal Insulators

Standard Terminal Insulators

Coors furnishes *standard* terminal insulators—available from stock—in various ratings and, also, can manufacture custom made insulators to meet your specific requirements. In the range of standard sizes, metal parts are bonded to the ceramic by Coors High Temperature Metalizing Techniques, thus producing strong hermetic ceramic-to-metal seals. The result is standard terminal insulators available for a wide range of requirements—insulators that have superior electrical and mechanical characteristics. Production is on a large quantity basis—you do not pay a premium for high quality, precision terminals.

At the IRE Show!
Coors Beryllium Oxide Ceramic

Coors is now in regular production of beryllium oxide ceramic. This new ceramic material has outstanding refractory and nuclear properties. It has better resistance to thermal shock than most other ceramic materials and conducts heat better than any other ceramic material. A good electrical insulator at elevated temperatures, these components are meeting the many advanced needs of the electronic industry. See this Coors ceramic material at the IRE Show or write for new data. **Booth 4005-6**

Coors

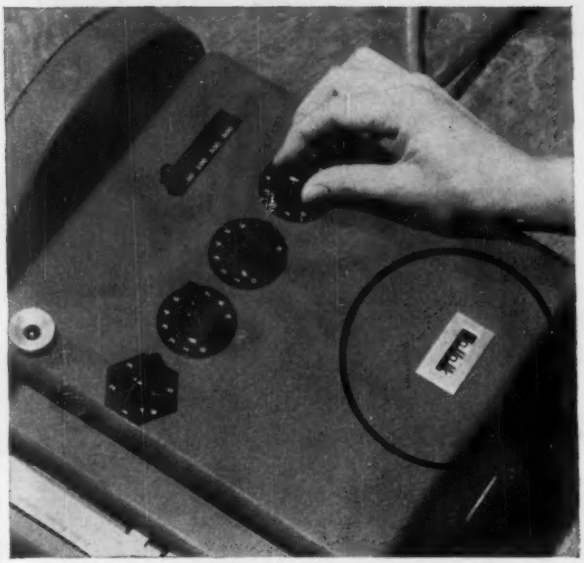
COORS PORCELAIN COMPANY

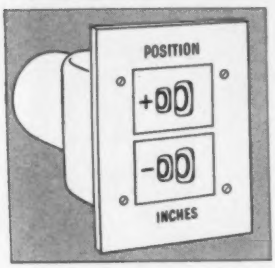
600 Ninth Street, Golden, Colorado

Veeder-Root READOUT Bulletin

Readout Counter used in Tape Preparation for Machine Tool Control

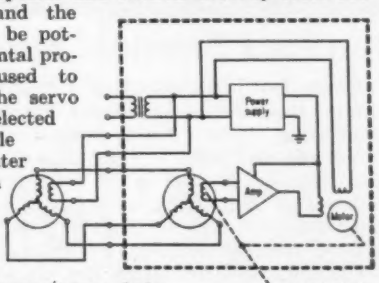
A Veeder-Root Series 1538 Remote Data Readout Counter provides tape feed control for the motorized tape punching unit of the new Potter & Johnston Tape Control System. The tape punch is used to program machine functions on P & J Automatic Turret Lathes. The counter automatically controls the amount of tape feed required for each turret face involved, and stops the tape at preselected address points. When the correct address point is reached, a combination of holes representing the machine command is punched into the tape. Counter is automatically reset for each turret face.





Servo Repeaters Drive Counters to Indicate Lineal Motion*

One of the ways to take advantage of digital readout for indicating and recording information at remote points is through servo repeaters. Applications in aircraft, for altimeters, navigational displays and similar instrumentation, suggest many other opportunities to use counters for more positive indication and control. A typical "system" is shown here where a counter is used for indicating nuclear reactor rod position. The servo repeater and counter actually form one packaged unit, and the whole device can be potted for environmental protection. When used to drive counters, the servo gear ratio is best selected to provide full scale travel of the counter for one revolution of the control transformer shaft.



Typical servo repeater/counter device that converts synchro data to digital readout.

Let Veeder-Root help you make Counters do more! Extensive design experience and precision production techniques make it possible for Veeder-Root to help you solve a wide variety of digital, readout, control and recording problems with counters — from the simplest ratchet to advanced readout and navigational devices. Send for information on specific applications or contact your local Veeder-Root Counting Engineer.

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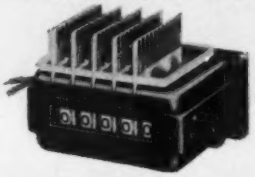
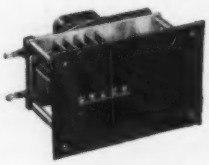
Veeder-Root Readout Device

This is the basic series of Remote Data Readout Counters. Some are available for standard applications, or design variations will be submitted based on requirements. They function basically as analog to digital converters.

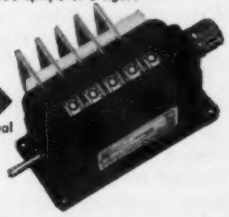
Series 1538/electrical reset/electrically actuated. Speed 1000 cpm, 3 or 5 figure





Series 1538/electrically actuated/manual reset. Speed 1000 cpm, 3 or 5 figure

Series 1606/mechanically actuated manual reset standard; bi-directional (non-reset) available. Speed 5000 cpm, up to 5 figures



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Sorensen precision controlled power is making a tremendous variety of jobs easier in scientific and industrial labs, in equipment design departments, on production lines, and in armed forces establishments.

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Incidentally, Sorensen application engineers are always glad to discuss with you your specific requirements. Sorensen & Company, Richards Avenue, South Norwalk, Conn. 9.50

Series Q . . . just one selection from the most comprehensive power-supply line on the market.

- 15 models
- Output: 6, 12, or 28 vdc, adjustable, approx. ±25%
- Regulation: As close as ±0.05% for line and load combined
- Power capacities: To approx. 200 watts
- Response time: 50 microseconds
- Ripple: All models below 0.02%; most below 0.01%

Input: 105-125vac, single-phase, 50/60 cps (can be used on 400 cps).
Write for data sheet DC290.

Sorensen

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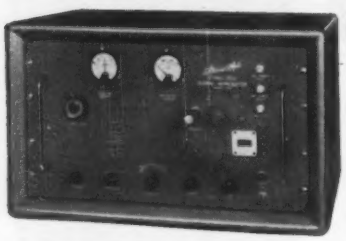
ULTRA STABLE
VARIABLE FREQUENCY
VERSATILE

Microwave signal sources with high rf stability... for test, research, inspection.

Model 300

INEXPENSIVE
Portable
Self-contained
Short-term stability — 1 part in 10^8.

10 mw power output for low power applications. Offers many features found only in much higher-priced instruments.



Model 500

EXTREME STABILITY
HIGH POWER
HIGH RELIABILITY
MODERATE COST

500 mw power output for maximum flexibility. The unexcelled frequency stability:
short-term deviation — 1 part in 10^8
long-term deviation — 1 part in 10^6
. . . is achieved with a high-gain dc amplifier, and patented AFC discriminator.

Models 300 & 500 operate at 8.5 to 9.6 Kmc/s. Also available — units at K, C and G-bands. Full year's warranty on all instruments. Write for complete information.

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Now on-stream day and night—Monsanto's new custom-engineered plant near St. Charles, Missouri—turning out semiconductor-grade SILICON.

Check into the form of Monsanto SILICON that best meets your needs:

Float-zone-refined single-crystal SILICON . . . **(a)** *doped* to desired resistivities of either "p" or "n" type and having high lifetimes **(b)** *undoped* high-resistivity (greater than 1,000 ohm cm.) "p" type with lifetime of more than 200 microseconds.

Polycrystalline SILICON . . . **(a)** *rods* designed for float-zone refining and capable of making single-crystal silicon of high-resistivity "p" type, or of being doped to desired levels of "p" or "n" type resistivities **(b)** *billets* with ultra-low base boron content for growing high-quality crystals.

To be certain you keep up to date and have all the information you need about Monsanto's semiconductor-grade SILICON, just write: *Monsanto Chemical Company, Inorganic Chemicals Division, Dept. Si-1, St. Louis 66, Missouri.*

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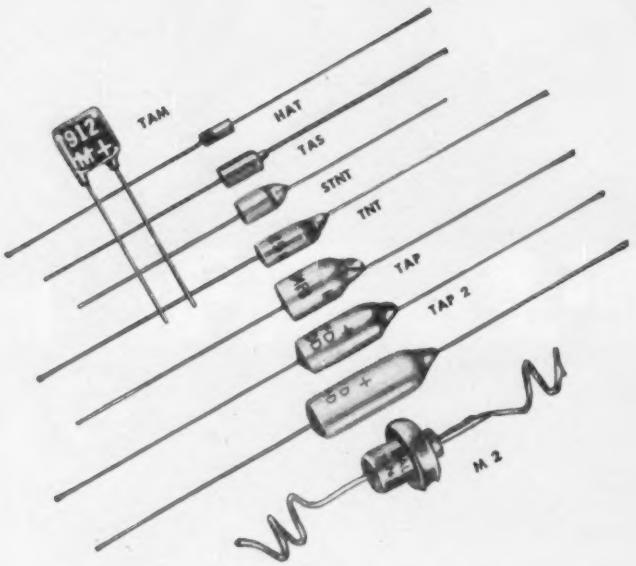
Mallory Miniature



From the Wide Line of Mallory Tantalum Capacitors... Nine Miniature Tantalums

Type	Description	Capacity Range	*W. Volts DC Rating at 85°C	Temperature Range	Case Style	Body Length	Body Diameter
HAT	Pellet Anode Liquid Electrolyte	1-10 mfd.	16-1V.	−20 to +65°C	Metal Case Axial Leads Insulated Case	.210" max.	.070" max.
TAS	Pellet Anode Solid Electrolyte	.33-330 mfd	35-6V.	−80 to +85°C	Metal Case Axial Leads	.250" to .750"	.125" to .341"
TAM	Pellet Anode Solid Electrolyte	4.7-56 mfd.	25-6V.	−55 to +85°C	Dip Coated Resin Upright Mounting	.188"	.313" square
STNT	Pellet Anode Liquid Electrolyte	4-40 mfd.	50-3V.	−55 to +85°C	Metal Case Axial Leads	.250"	.145"
TNT	Pellet Anode Liquid Electrolyte	8-80 mfd.	50-3V.	−55 to +85°C	Metal Case Axial Leads	.375"	.145"
TAP-1	Pellet Anode Liquid Electrolyte	2-30 mfd.	90-6V.	−55 to +85°C	Metal Case Axial Leads	.500"	.238"
TAP-2	Pellet Anode Liquid Electrolyte	11-140 mfd.	90-6V.	−55 to +85°C	Metal Case Axial Leads	.660"	.238"
TAP-3	Pellet Anode Liquid Electrolyte	30-325 mfd.	90-6V.	−55 to +85°C	Metal Case Axial Leads	.875"	.238"
M 2	Pellet Anode Liquid Electrolyte	11-140 mfd.	90-6V.	−55 to +150°C	Metal Case Axial Leads	.500"	.287" (Body) .484" (Flange)

WVDC at 65° for HAT

Tantalums...

Tiny in everything... but performance

When miniaturization squeezes your circuits . . . and you need smaller and smaller tantalum capacitors, look to the broad Mallory line for just the right sizes to fit your tightest space requirements. Tiny in everything but performance, Mallory miniature tantalums will meet all your needs for ratings, mountings and service.

Mallory pioneering has developed a complete line of miniature tantalums. For instance, there's the encapsulated Type TAM . . . an ideal space-saver for printed circuits. Metal-cased, axial lead types range in size down to the micro-miniature Type HAT, the smallest metal case capacitor made. Other liquid and solid electrolyte types cover a broad range of capacity and voltage ratings. Type M2—for 150°C service—is a miniature version of the high temperature tantalums pioneered by Mallory.

Including the miniatures, there are 16 types of Mallory tantalums to choose from—ranging up to the high-capacity types for 200°C service. In life tests and actual service, they've been proven unequalled for stability of capacitance, equivalent series resistance and low leakage values.

For expert consultation on your circuit requirements, see your Mallory capacitor specialist . . . and write today for technical data on the Mallory tantalum line.

. . . And Seven Others

TAF: foil anode, 85°C rating, .25-440 mfd.
XTK: small case, 175°C rating, 2-70 mfd.
XTM: small diameter, 175°C rating, 4-140 mfd.
XTL: smallest 200°C rating, 3.5-120 mfd.
XTH: 200°C rating, 7-240 mfd.
XTV: high capacity, 175°C rating, 18-1300 mfd.
XTO: 200°C rating, 7-240 mfd.

Immediate Delivery on All 16 Types

Mallory Capacitor Company
Indianapolis 6, Indiana
a division of

P.R. MALLORY & CO. Inc.
MALLORY

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Dayton, Ohio
Allied Supply Co.
Denver, Colo.
Denver Electronics
Detroit, Mich.
Ferguson Electronic Supply
Downsview, Ont.
Alpha Aracon Radio Co.
Fords, N.J.
Atlas Electronics
Houston, Texas
Harrison Equipment Co., Inc.
Lenert Company
Indianapolis, Ind.
Graham Electronics
Los Angeles, Calif.
California Electronic Supply
Kierulff Electronics, Inc.
Radio Product Sales
Minneapolis, Minn.
Northwest Radio
Montreal, Que.
Canadian Electrical Supply Co.
Mountainside, N.J.
Federated Purchaser, Inc.
New York, N.Y.
Harrison Radio Corp.
Harvey Radio Co., Inc.
Hudson Radio & TV Corp.
Lafayette Radio
Terminal Electronics
Oakland, Calif.
Elmar Electronics, Inc.
Palo Alto, Calif.
Zack Radio Supply Co.
Pasadena, Calif.
Electronic Supply Corp.
Pittsburgh, Pa.
Radio Parts Co.
St. Louis, Mo.
Olive Electronics
Tampa, Florida
Thurow Distributors, Inc.
Toronto, Ont.
Electro Sonic Supply
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Tulsa, Okla.
Engineering Supply Co.
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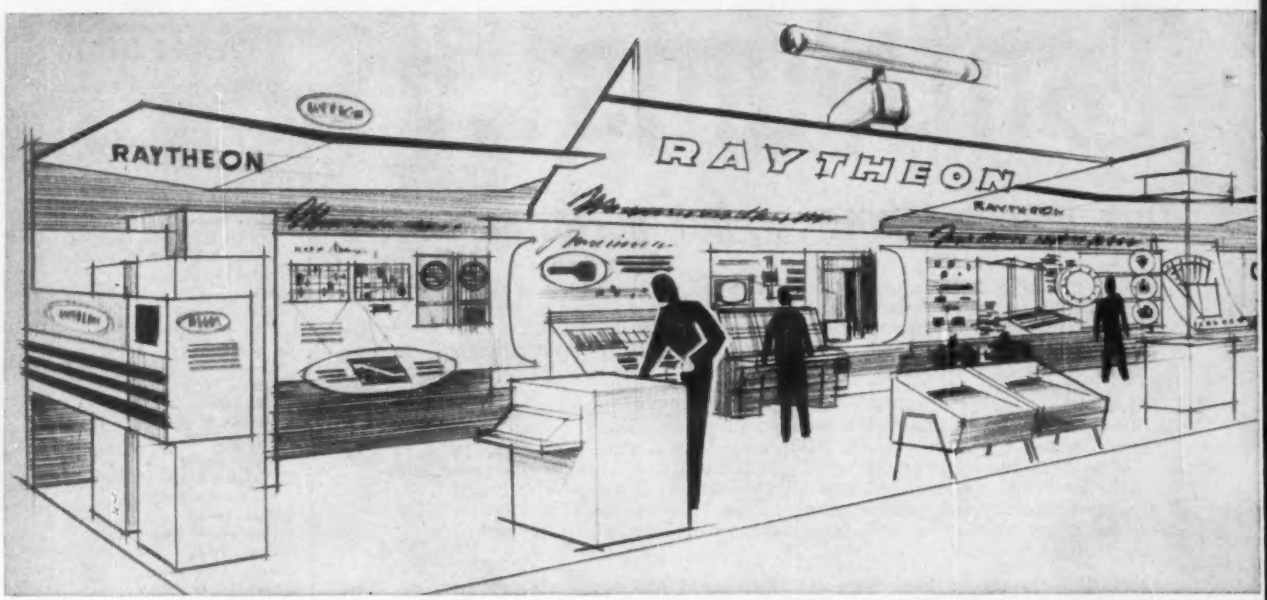
Electronic Industrial Sales

See these new Raytheon Product



INDUSTRIAL COMPONENTS DIVISION

New Kilo-line recording storage tubes provide 1000 TV lines at 50% modulation. These high-resolution, low-noise tubes for frequency and scan conversion utilize a specially designed tetrode electron gun for a resolution of 1,000 TV lines at 50% modulation and provide better control over beam cut-off than conventional triode guns. Applications include: (1) scan conversion for bright display radar and moving target indicators, (2) slow-down video for still picture telephone transmission, (3) stop-motion video.

CIRCLE 100

New pointer knobs virtually eliminate parallax. Two new sloping pointer style control knobs have been added to Raytheon's widely used commercial and military knob line. The new pointer series complies fully with military specifications and is available in black or grey, with or without dial skirts; in mirror or non-reflective matte finish. Colors are available on special order. Raytheon's complete line of knobs includes 206 styles —9 standard types in 6 sizes, plus tactile shapes, color and color caps.

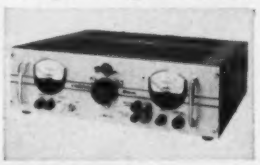
CIRCLE 101

COMMERCIAL APPARATUS & SYSTEMS DIVISION

New Voltage-regulating PF transformer holds voltages to within ± 3%. The new Raytheon voltage regulating PF transformer maintains plate and filament voltages to within ± 3% of rated output with line voltage variation of from 100 to 130 volts. PF transformers are now available in three standard models with ratings up to 380 VDC at 250 MA. They eliminate need for VR tubes and special circuitry.

CIRCLE 159

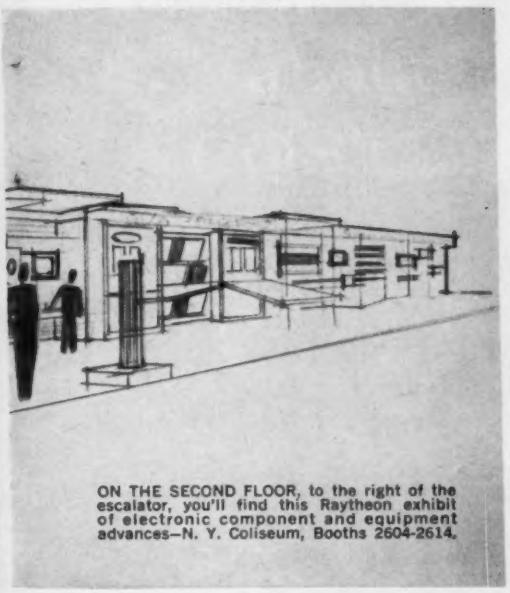
Sorensen Series Q line of power supplies for 6, 12 or 28 VDC regulated. The Sorensen Series Q power supply line is comprised of 15 different models with outputs of 6, 12 or 28 VDC, adjustable approximately ± 25%. Voltages are regulated within ± 0.05% for load and line combined. Power capacities range up to 200 watts. The complete line of Sorensen power supplies covers requirements from 600,000 volts down to 3 volts. Sorensen also offers a line of frequency changers and line voltage regulators.



CIRCLE 160

Visit us at the New York Coliseum, Booths 2604-2614

Developments at the IRE Show

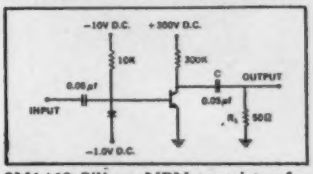


ON THE SECOND FLOOR, to the right of the escalator, you'll find this Raytheon exhibit of electronic component and equipment advances—N. Y. Coliseum, Booths 2604-2614.

SEMICONDUCTOR DIVISION

New "Avalanche Mode" Silicon Transistor switches in 2½ milli-μsec.

A guaranteed switching time of 10 millimicroseconds maximum (when used in the switching circuit shown) with speeds faster than 1½ millimicroseconds in some applications is now possible with Raytheon's new



2N1468 Silicon NPN transistor for avalanche mode operations. Other features: 40 watts peak power, average power dissipation of 250 milliwatts, maximum operating temperature of 125°C.

CIRCLE 166

New Silicon Mesa Transistor in Subminiature Package.

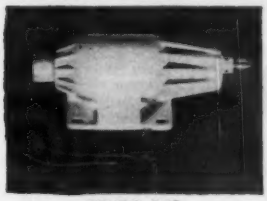
Raytheon's Semiconductor Division announces the availability of high-performance Silicon Mesa transistors in subminiature packages (.130" D., .160" H.). These units feature the reliable "Mesa" construction, alpha cut-off frequencies up to 50 megacycles and close control of DC base-current gain in high-speed switching types.

CIRCLE 165

MICROWAVE AND POWER TUBE DIVISION

Four new ruggedized backward wave oscillators cover 1-12.4 kmc.

Four compatible Raytheon BWO's now provide continuous frequency coverage from 1 to 12.4 kmc. They utilize interdigital delay-line structures for greater ruggedness and heat dissipating characteristics, are smaller and lighter than their predecessors and have improved fine-grain tuning variations with minimized fine-grain power output variations. Forced air cooling is not required under normal operating conditions.



CIRCLE 161

New ferrite circulators for masers, parametric amplifiers and radio astronomy.

A standard line of extremely compact, low-frequency, three-port ferrite circulators is now available from Raytheon. Now, a total of twenty-eight units are avail-

able – for UHF as well as S- and L-band applications. The new UHF unit extends the frequency range down to 400 mc. These circulators are supplied with fixed permanent magnet fields (as illustrated) or with tuned magnetic fields for full performance over a broader band.

CIRCLE 162

MACHLETT LABORATORIES

UHF planar triode has 60% more cathode current capacity.

This unique, Machlett developed UHF planar triode with ceramic envelope has 1.6 times the cathode current rating of the more conventional tubes in current use. The new ML-7211 has applications in communications, navigation, telemetering, radar and missile equipment of the most advanced design.

CIRCLE 163

Improved camera tube for general closed-circuit TV applications.

Machlett's novel vidicon camera tube features photoconductor guard and self-aligning beam eliminating the need for permanent magnets or coils. This tube will be exhibited at the IRE along with Machlett's water-cooled triode rated at 20-megawatts peak power, a scan conversion tube for conversion of radar information to TV display, and a high-power vapor cooled tube for general purpose modulator, amplifier and oscillator services.

CIRCLE 164

RAYTHEON COMPANY
Waltham, Massachusetts

RAYTHEON *Excellence in Electronics*

NEW KLYSTRON POWER SUPPLY

Features Wide Voltage Range, Hi-Power Capacity and Small, Compact Construction

SPECIFICATIONS

	BEAM	REFLECTOR	GRID
Voltage Range	−200 to −4000 v	0 to −1000 v	0 to +150 v 0 to −300 v
Regulation	0.01%	0.01%	0.01%
Max. Ripple	3 mv	3 mv	5 mv
Current	0 to 150 ma (360 w max)	—	5 ma (max)

Power Requirements: 105-125 v, 50/60 cps Dimensions: 12¼" H x 19¼" W x 17¾" D Weight: 125 pounds

This new *Microline*® Universal Klystron Power Supply Model 62A1 is a good example of many superior engineering developments coming from the modern Clearwater plant of Sperry Microwave Electronics Company.

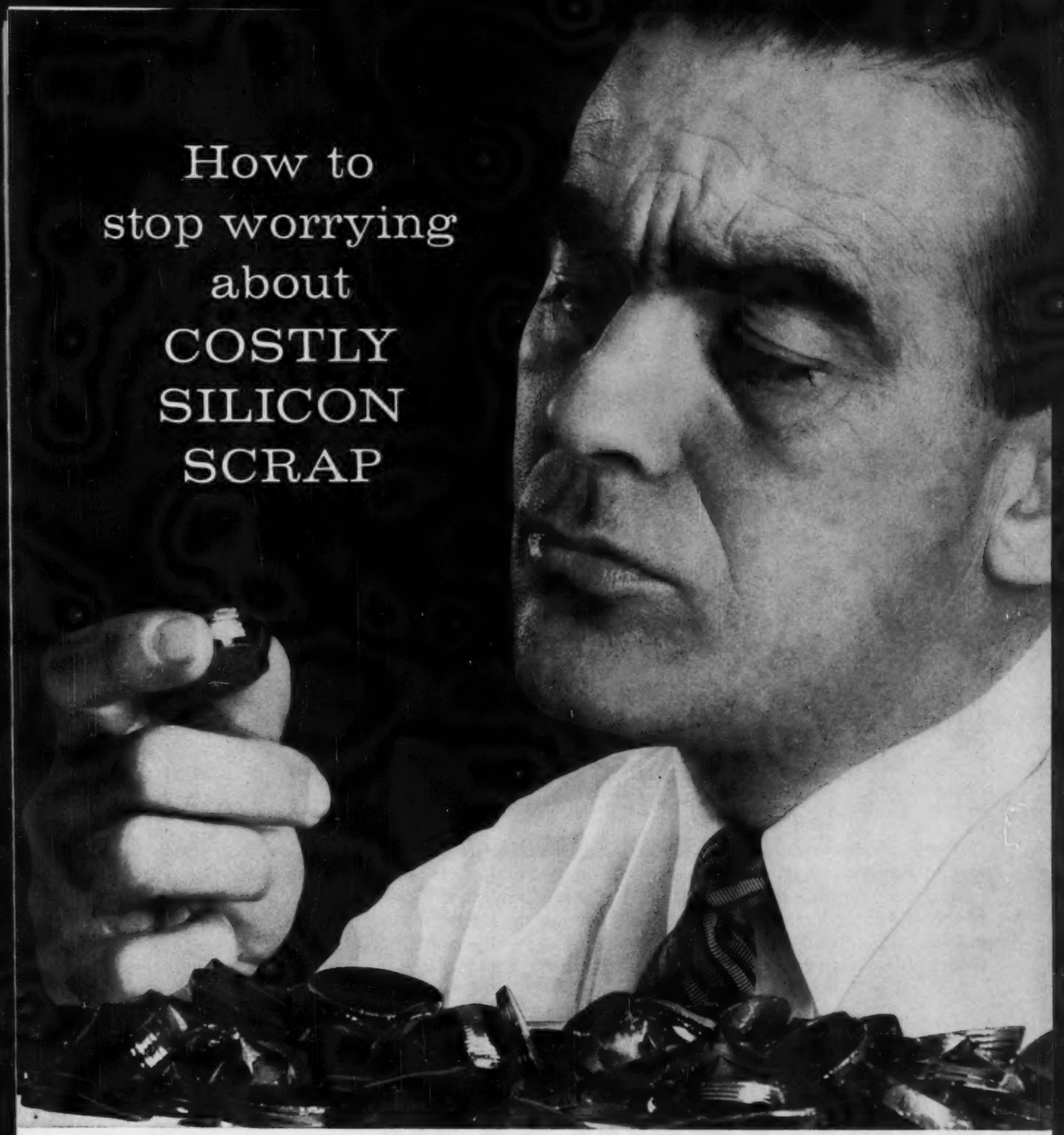
Using conservatively-rated components, the Model 62A1 provides a voltage range from 200 to 4,000 volts meets the needs of nearly every klystron available today, as well as several small cw magnetrons. Internal modulator supplies sawtooth, square wave or sine wave modulation . . . external modulation from either a high or low level outside source is committed through the use of an internal amplifier.

In addition to these advantages, the Model 62A1 requires about one-half the space of the usual power supply—and operating convenience is emphasizes by grouping controls for simple, easy adjustment. Write for Microline 62A1 data sheet.

Visit our booth 2432-2438, 1960 IRE Show, March 21-24.

SPERRY

SPERRY MICROWAVE ELECTRONICS COMPANY, *CLEARWATER, FLORIDA • DIVISION OF SPERRY RAND CORPORATION*



Want to overcome the nagging problem of costly silicon scrap?

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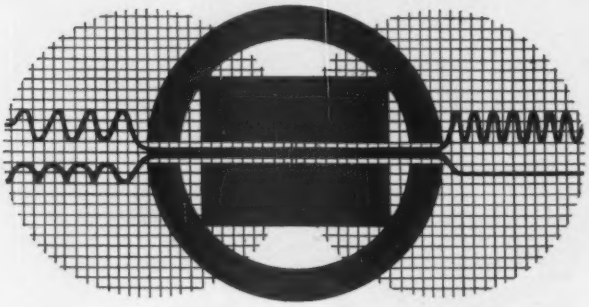
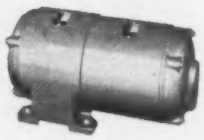
TO MEET YOUR PRECISE NEEDS

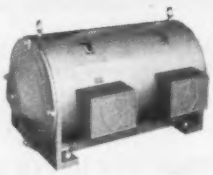


Converting power to your specific requirements is the specialty of the Precision Power Division of American Electronics. Through its years of experience devoted exclusively to solving power conversion problems, have come many new rotary and solid state power conversion developments. Thousands of these dependable AEI products today serve the aircraft, missile, electronics and industrial fields. For all of your precision power needs, depend on one reliable source—American Electronics' Precision Power Division. Please call on our field representative and engineering staff to discuss your specific power requirements.

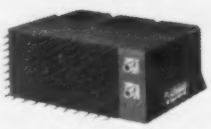
Brushless Inductor Type Motor-Alternator Sets • 300 watts to 30 KVA, 100 cycles to 10,000 cycles, fixed or variable, single or 3 phase.



Revolving Field Motor-Alternator Sets • 3 KVA to 125 KVA, 50 cycles to 10,000 cycles fixed or variable, single or 3 phase.



Filament Line Voltage Regulators, Magnetic Servo Amplifiers, Magnetic Amplifiers, Line Voltage Regulators.



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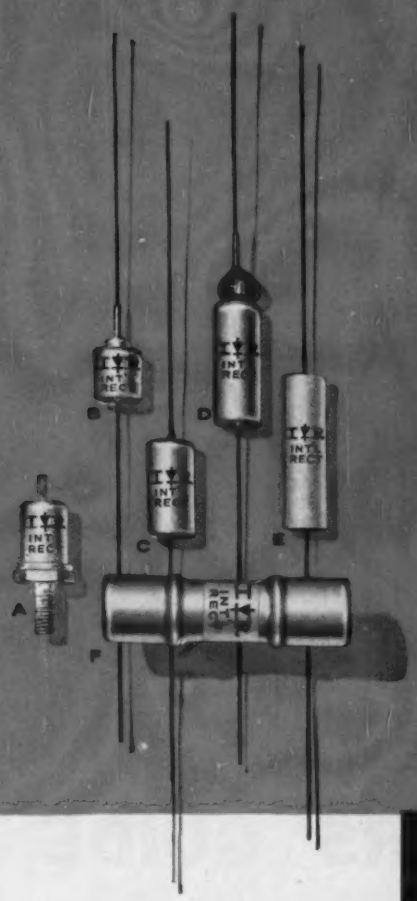

Type Number	Peak Inverse Voltage, Volts	Rectified DC Output Current, MA	Max. Voltage Drop @ Rated Current, Volts
Standard Types — Convection Cooled			
1N1130	1500	300	4.5
1N1131	1500	300	4.5
1N596	600	125	3.0
1N597	800	125	3.0
1N598	1000	125	3.0
1N1406	600	100	5.0
1N1407	800	100	5.0
1N1408	1000	100	5.0
1N1409	1200	100	5.0
1N1410	1500	100	6.25
1N1411	1600	100	7.5
1N1412	2000	100	8.25
1N1413	2400	100	7.5
1N2373	600	150	3.0
1N2374	1000	150	3.0
1N2375	1500	130	4.5
1N2376	2000	130	7.5
1N2377	2400	100	9.0
1N2378	3000	100	9.0
1N2379	4000	65	15.0
1N2380	6000	65	22.5
1N2381	10000	40	37.5

Type Number	Peak Inverse Voltage, Volts	DC Output Current @ 75°C, MA	Max. Voltage Drop @ Rated Current, Volts
Standard Types — Convection Cooled			
1N1133	1500	75	15.0
1N1134	1500	100	7.5
1N1135	1800	65	18.0
1N1136	1800	85	9.0
1N1137	2400	50	24.0
1N1138	2400	60	12.0
1N1139	3600	65	27.0
1N1140	3600	65	18.0
1N1141	4800	60	36.0
1N1142	4800	50	24.0
1N1143	6000	50	45.0
1N1143A	6000	65	30.0
1N1144	7200	50	54.0
1N1145	7200	60	36.0
1N1146	8000	45	60.0
1N1147	12000	45	60.0
1N1148	14000	50	52.0
1N1149	16000	45	60.0
High Current Types — Forced Cooled at 3000 LFM			
1N1745	1500	300	15.0
1N1746	1500	360	7.5
1N1747	1800	270	18.0
1N1748	1800	330	9.0
1N1749	2400	220	24.0
1N1750	2400	270	12.0
1N1751	3600	290	27.0
1N1752	3600	280	18.0
1N1753	4800	230	36.0
1N1754	4800	220	24.0
1N1755	6000	210	45.0
1N1756	6000	280	30.0
1N1757	7200	240	54.0
1N1758	7200	230	36.0
1N1759	8000	220	60.0
1N1760	12000	220	60.0
1N1761	14000	240	52.0
1N1762	16000	220	60.0

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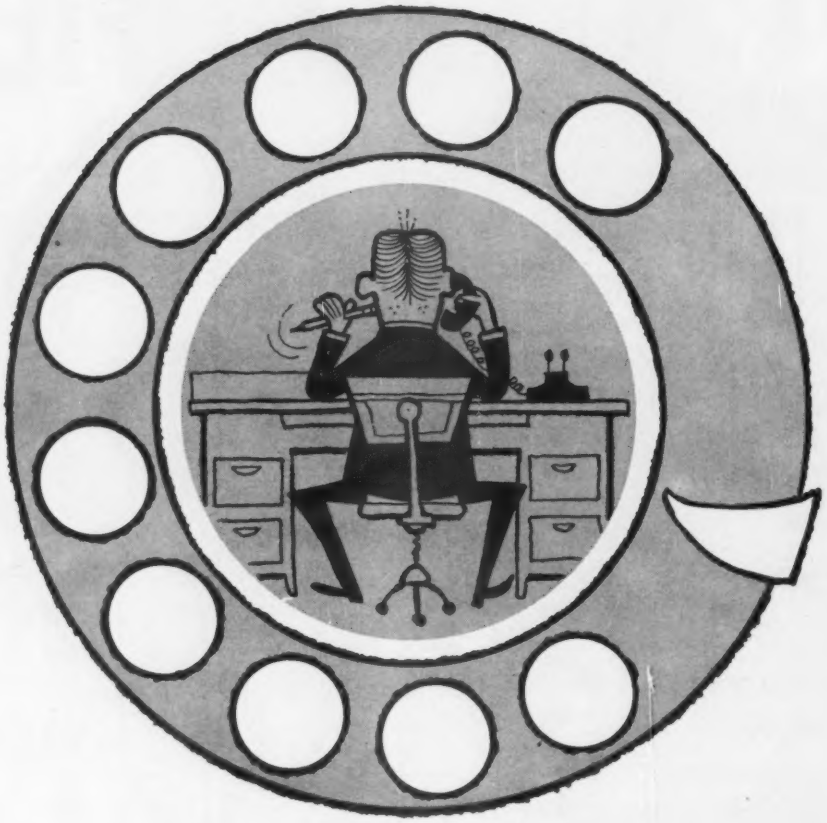
Who's the local rep? What's his number?



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You'll find the local representative . . . his name, telephone number . . . his address. You'll find such detailed information about more than 25,000 local sales offices of more than 4,000 major manufacturers.

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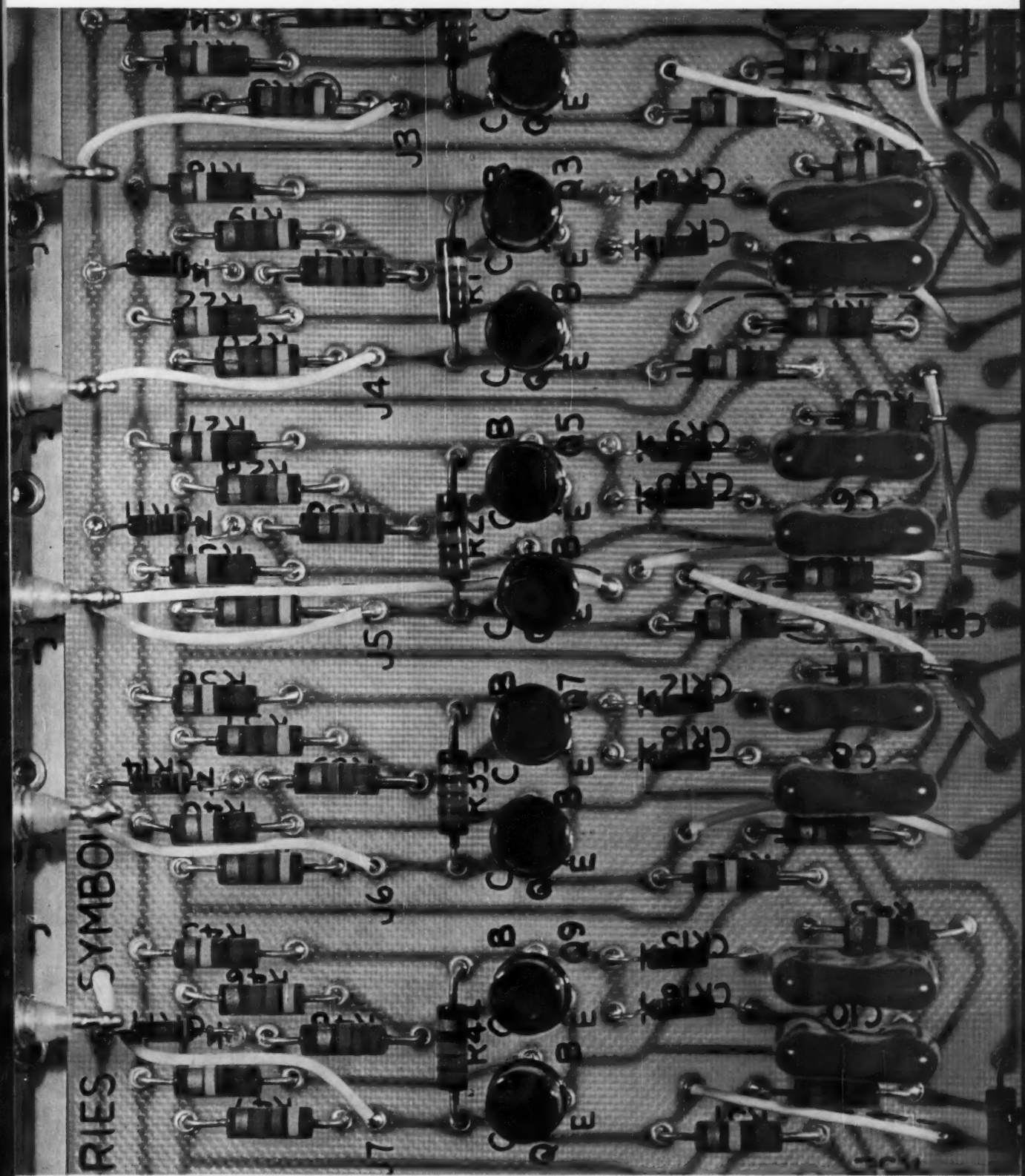
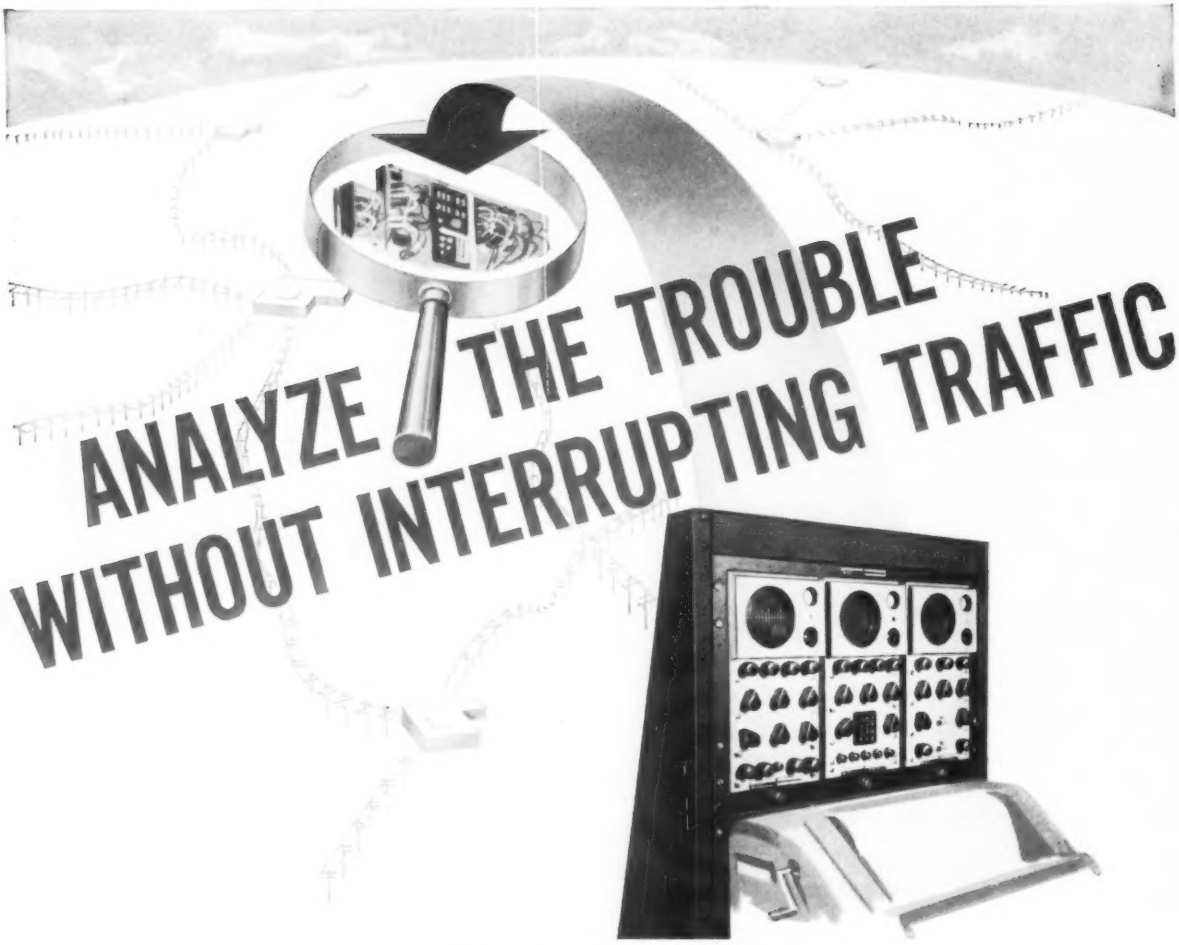
At 00h00m01s GMT March 1, 1960, Martin logged its 457,080,000th mile of space flight



Without electronics it is impossible to design, build, test, launch, guide, track or communicate with a missile. That is why **40% of Martin's 7,500 engineers are electronic/electrical engineers.**

MARTIN



ANALYZE THE TROUBLE WITHOUT INTERRUPTING TRAFFIC

how to reduce down-time on telegraph and data transmission circuits

Radiation's new Telegraph Distortion Monitoring System (TDMS) provides in one compact assembly complete testing, monitoring and signal waveform analyses of telegraph circuits and data transmission lines. This versatile unit makes possible on-line quality control of communications links. It indicates malfunctions, analyzes their causes—without interrupting the flow of traffic.

The Radiation TDMS, with miniaturized components for space-saving compactness, can replace most test equipment now required for teletype maintenance and monitoring. Thus, in addition to reducing circuit outage, the TDMS permits reduction of test equipment costs and increases maintenance efficiency. Portability is achieved at the "push of a button".

For a detailed description of the operation and capabilities of the TDMS, write for Brochure RAD E-100B. Address Radiation Incorporated, Dept. EL3, Melbourne, Fla.

THE ELECTRONICS FIELD ALSO RELIES ON RADIATION FOR . . .

RADIPLEX—50—channel low-level multiplexer with broad data processing applications. Features rugged solid-state circuitry, almost unlimited programming flexibility, unique modular construction for compactness and exceptional ease of operation and maintenance.

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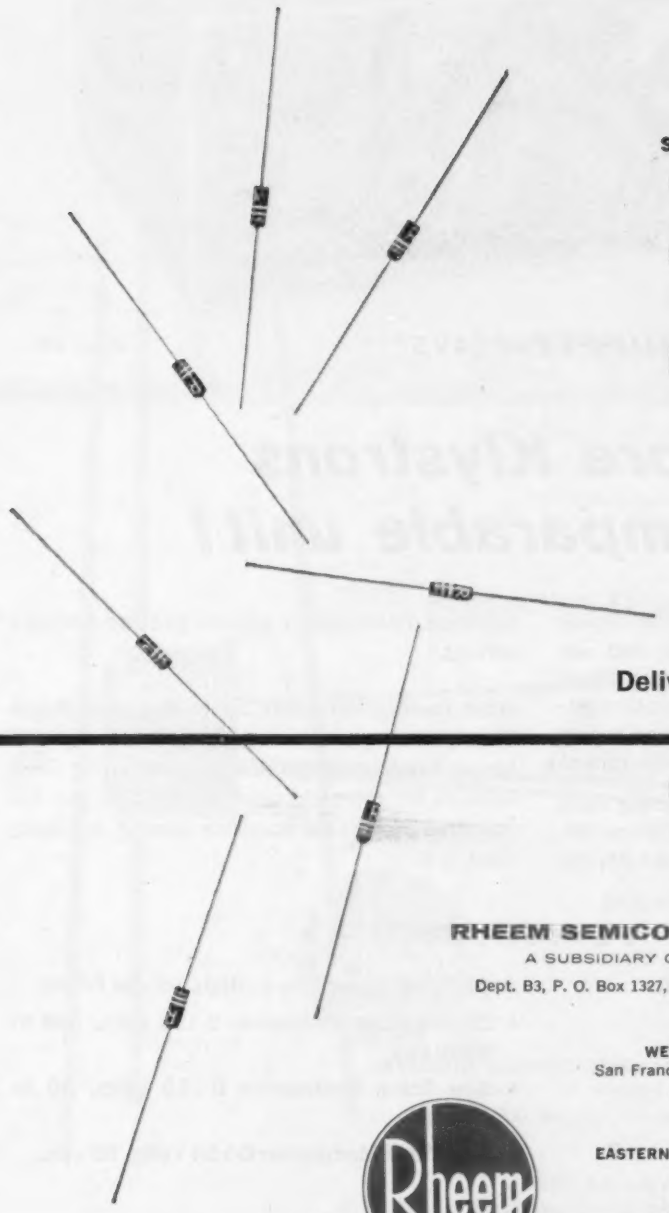

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Model 438

Operates more Klystrons than any comparable unit!

This new Narda Wide Range Klystron Power Supply operates virtually all medium and low voltage Klystrons, as well as some high voltage tubes (at reduced power output). It literally operates more Klystrons, including Sperry and Varian tubes, than any other unit in its price range!

What's more, all components, including tube sockets, are operated within manufacturers' ratings. (Many other supplies exceed plate-cathode, cathode-filament or socket-ground voltage ratings.)

Want more information about this new Power Supply that gives you greater versatility and longer trouble-free service at lower cost? Then write us for complete spec sheets. Ask, too, for your free copy of our complete catalog. Address: Dept. E-6.

FEATURES

- **250-700 volt Beam Supply, 0-65 ma.**
- **0-1000 volt Reflector Supply**
- **Accurate Ten-Turn Dial Calibration**
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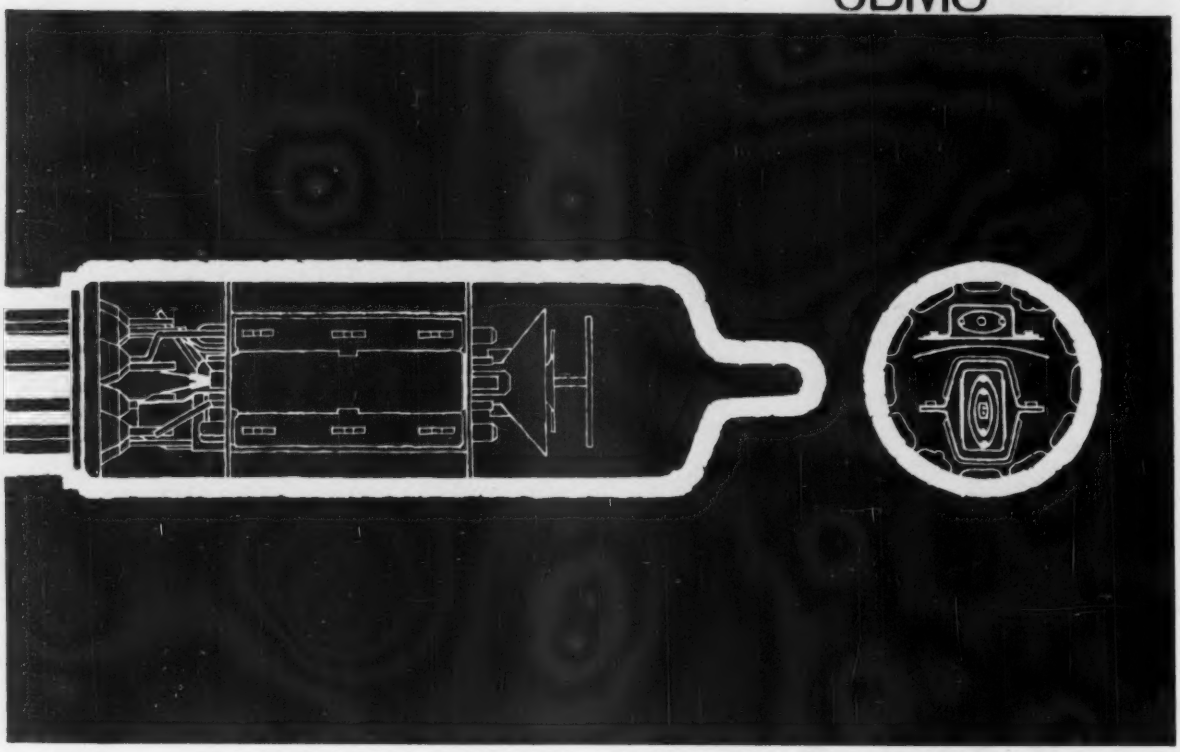


triode pentode

Combined triode and output pentode with separate cathodes intended for use as a combined a.f. amplifier and output tube or frame oscillator and output tube.

characteristics

Pentode section			
V_a	200	250	V
V_{g2}	200	250	V
I_a	35	28	mA
I_{g2}	7.0	5.7	mA
V_{g1}	−16	−22.5	V
g_m	6.4	5.0	mA/V
r_a	20	25	kΩ
μ_{g1-g2}	9.5	9.5	
Triode section			
V_a		100	V
I_a		3.5	mA
V_g		0	V
g_m		2.5	mA/V
r_a		28	kΩ
μ		70	

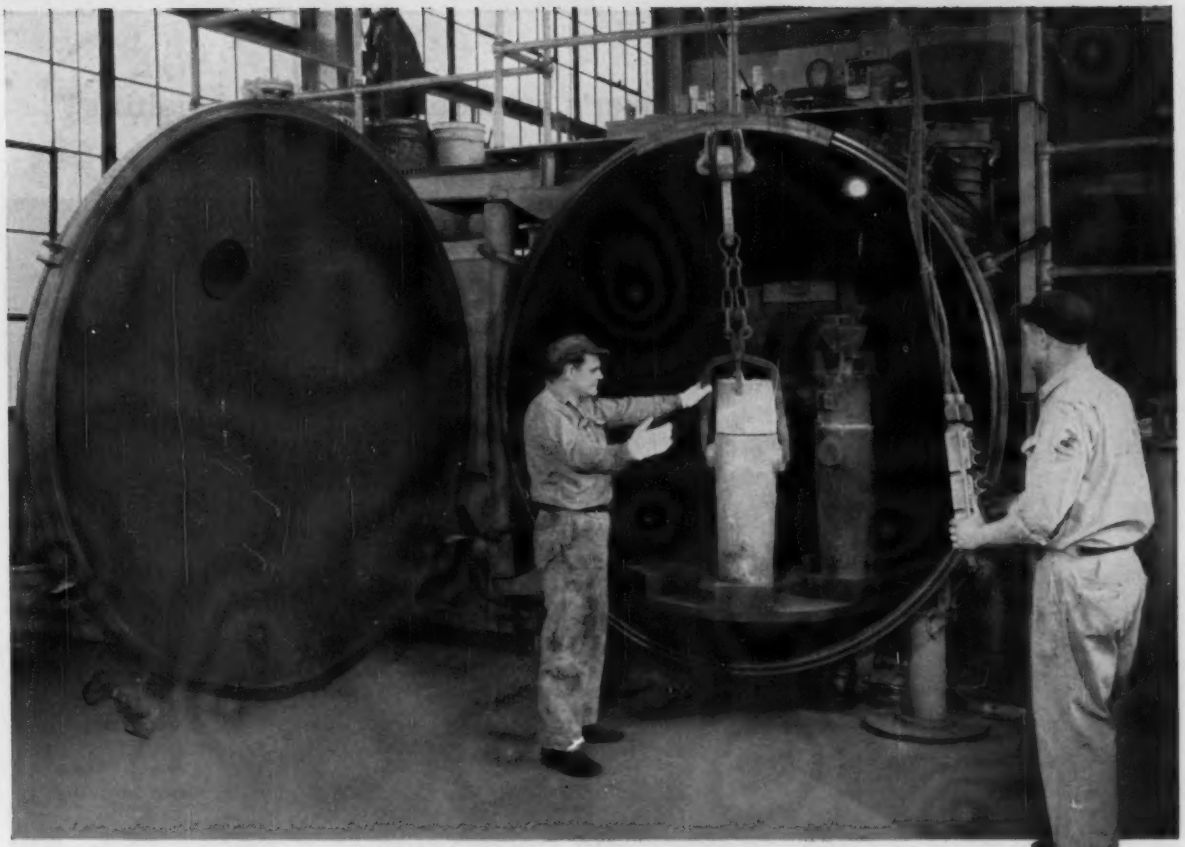
SUPPLIES AVAILABLE FROM
In the U.S.A.
International Electronics Corporation
81 Spring Street, New York 12, N.Y.
Worth 6-0790.
In Canada
Rogers Electronic Tubes & Components
116 Vanderhoof Avenue, Toronto 17, Ontario.
Hudson 5-8821.

'Mullard' is the trade mark of Mullard Ltd.

Mullard

ELECTRONIC TUBES BRITAIN'S FIRST CHOICE FOR FIRST EQUIPMENTS

MULLARD OVERSEAS LTD., MULLARD HOUSE, TORRINGTON PLACE, LONDON, ENGLAND



NOW EXCLUSIVELY VACUUM MELTED
KARMA High Resistance Alloy
THERLO Glass Sealing Alloy

This dramatic "first" in the manufacture of nickel alloys by Driver-Harris has been achieved by expanded vacuum melting capacity. It is still another example of our continued leadership in producing electrical and electronic nickel alloys of the highest purity.

D-H vacuum melting produces alloys of higher ductility and tensile properties. These are achieved by greatly reducing inclusions, especially oxides and nitrides. Other direct benefits are elimination of gas, not only from the surface but from the entire mass, and general improvement in the electrical, electronic and mechanical properties to meet critical specifications.

For additional information about Karma, Therlo and the other 130 high-nickel alloys manufactured by Driver-Harris, write for a copy of the D-H Alloy Manual.

*T.M. Reg. U.S. Pat. Off.

VACUUM MELTED KARMA* *High Resistance Wire*

The temperature coefficient of superior KARMA resistance wire has been improved to less than ±10 parts per million from —60°C. to +125°C. Higher stability and linearity are added to these important properties.

- Low thermal EMF against copper (equaled only by Manganin)
- Improved ductility
- High resistance to oxidation
- Wire sizes down to .0005"
- 800 ohms per circular mil foot

VACUUM MELTED THERLO* *Glass Sealing Alloy*

Improved workability is the major result of vacuum melting THERLO . . . the long established cobalt, nickel, iron alloy for sealing to hard or thermal shock resistant glass.

THERLO also:

- Produces a permanent vacuum-tight seal with simple oxidation procedure
- Resists mercury
- Is readily machined and formed—deep drawn or spun
- Can be welded, soldered, brazed
- Is available as rod, wire, strip, sheet foil—and in special shapes

DRIVER-HARRIS* COMPANY

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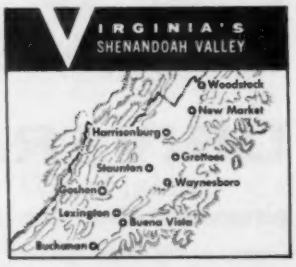
MAKERS OF THE MOST COMPLETE LINE OF ALLOYS FOR THE ELECTRICAL, ELECTRONIC, AND HEAT-TREATING INDUSTRIES

"Around here, good manpower's as plentiful as good fishing!"

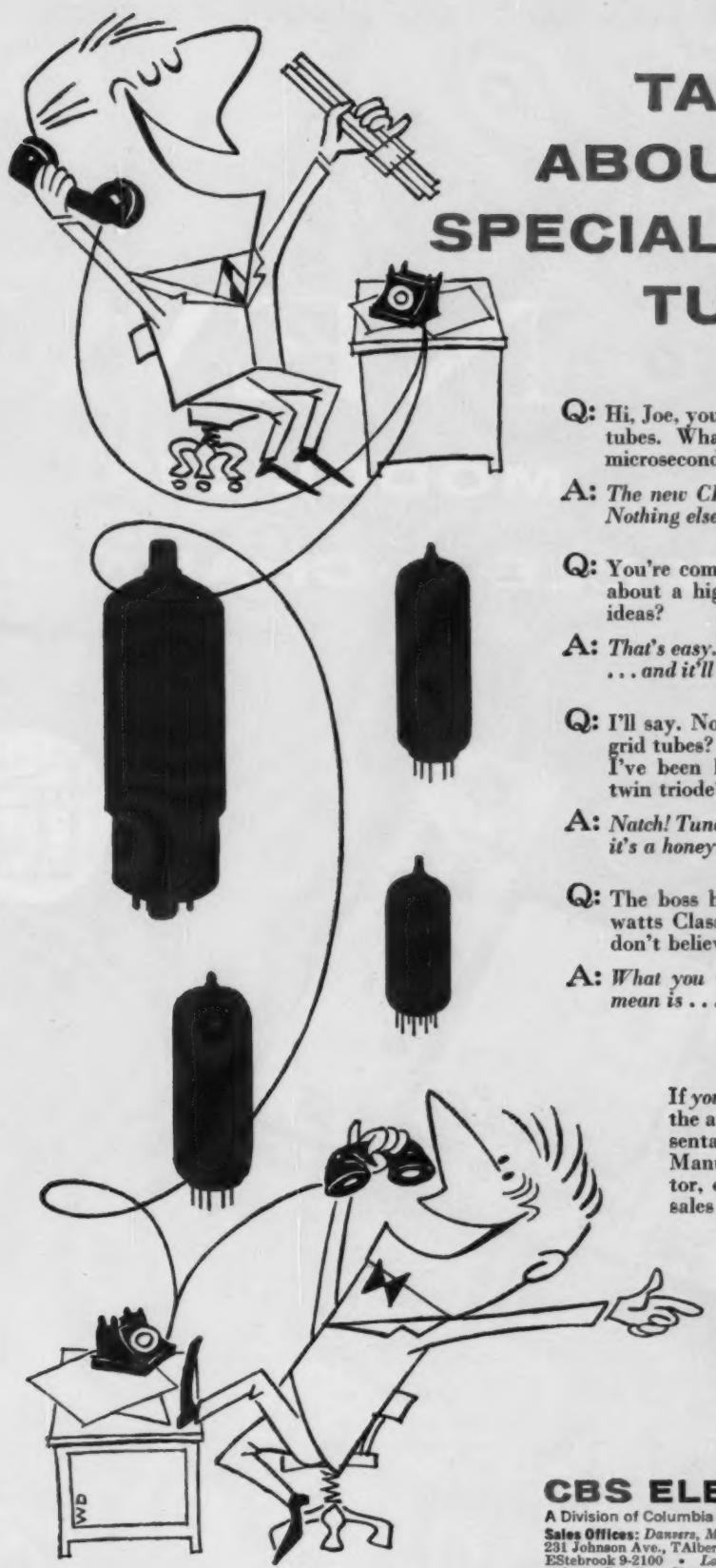
A plant in Virginia's Shenandoah Valley pays profits in production . . . and dividends in pleasant living. For this resource-rich area is rich, too, in home-grown manpower. And you live in a vacation land where you can hook a bass or play a round of golf between closing time and dinner time, during the Shenandoah Valley's delightfully long season for out-of-door fun. ■ Ask VEPCO about the friendly community and governmental climate and many other plus factors that have attracted nationally known industrial giants to the Valley, and created successful home grown industries, too. For facts and complete, confidential site finding help, write, wire or phone VEPCO today.



VEPCO **VIRGINIA ELECTRIC and POWER COMPANY**

Clark P. Spellman, Manager—Area Development, Electric Building, Richmond 9, Virginia • MIlton 9-1411

SERVING THE TOP-OF-THE-SOUTH WITH 1,990,000 KILOWATTS — DUE TO REACH 2,580,000 KILOWATTS BY 1962



TALKING ABOUT NEW SPECIAL-PURPOSE TUBES...

Q: Hi, Joe, you're supposed to be the expert on tubes. What's the best tube for a millimicrosecond pulse amplifier?

A: *The new CBS 7548 secondary-emission tube. Nothing else can touch it. Do you read me?*

Q: You're comin' in loud and clear. Now how about a high-voltage shunt regulator. Any ideas?

A: *That's easy. The CBS 6792 is the only answer . . . and it'll handle up to 25 kv. That hold you?*

Q: I'll say. Now what about these new frame-grid tubes? Are they as good as I hear? And I've been hearing plenty. Is there a good twin triode?

A: *Natch! Tune in on the new CBS ECC88/6DJ8; it's a honey.*

Q: The boss has a weird idea he can get ten watts Class C out of a T-6½ miniature. I don't believe it, even ICAS.

A: *What you want, boy, is watts. And what I mean is . . . you want the new CBS 5763.*

If *you* need answers on CBS tubes, call the answer man, your CBS tube representative. You can reach him at your Manufacturers Warehousing Distributor, or at your local CBS Electronics sales office. Call today.

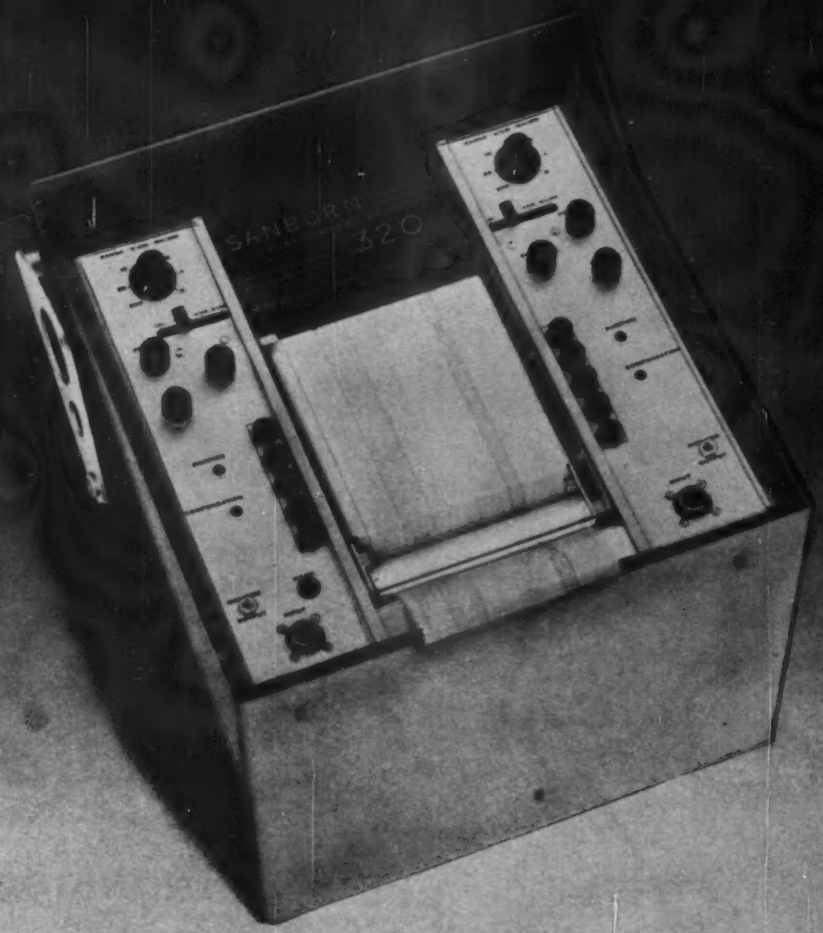
CBS ELECTRONICS, Danvers, Mass.
A Division of Columbia Broadcasting System, Inc.

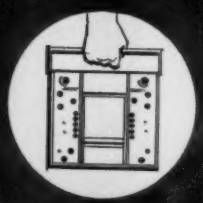
Sales Offices: *Danvers, Mass.*, 100 Endicott St., SPring 4-2360 • *Newark, N. J.*, 231 Johnson Ave., TAlbert 4-2450 • *Melrose Park, Ill.*, 1990 N. Mannheim Rd., EStebrook 9-2100 • *Los Angeles, Calif.*, 2120 S. Garfield Ave., RAymond 3-9081 *Atlanta, Ga.*, Cary Chapman & Co., 672 Whitehall St., JAckson 4-7388 • *Minneapolis, Minn.*, The Heimann Co., 1711 Hawthorne Ave., FEderal 2-5457

NEW

MODEL 320

PORTABLE 2-CHANNEL...

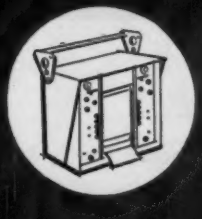


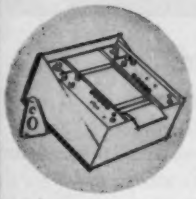


The new Sanborn Model 320 system — for general purpose DC recording in any part of the plant or on field assignments — combines rugged current-feedback amplifiers, 2-channel recorder assembly and dependable all-transistor circuitry in less than a cubic foot of space. And the many advantages of Sanborn multi-channel systems are incorporated in the new portable 320 — low impedance, enclosed galvanometers; clear, permanent traces made by heated styli; rectangular coordinate charts. Most components for each channel are mounted on one easily serviced card; others are readily accessible. The control panel permits easy access to the controls for each channel . . . provides for observation of 6 inches of the chart . . . and it can be set up for use vertically, horizontally or at a 20° angle using the adjustable stand/carrying handle.

Your nearest Sanborn Sales-Engineering Representative can provide you with complete data or write the main office in Waltham.
Sales-Engineering Representatives are located in principal cities throughout the U. S., Canada and foreign countries.

DIRECT WRITING SYSTEM





- **up to 0.5 millivolt/mm sensitivity**
- **inputs floating and guarded for each channel**
- **rectangular coordinate charts full 50 mm wide**
- **only 12¾" square, 8¾" deep**
- **4 pushbutton chart speeds**
- **completely transistorized**

SPECIFICATIONS

electrical

Sensitivity Ranges . . . . 0.5, 1, 2, 5, 10, 20 mv/mm and v/cm
Input Impedance . . . . ½ megohm on mv/mm ranges and 1 megohm on v/cm ranges
Frequency Response . . . . . 3 db down at 125 cps, 10 div peak-to-peak
Common Mode Voltage . . . . . ± 500 volts maximum
Common Mode Rejection . . . . . 140 db minimum DC
Linearity . . . . . maximum non-linearity — 0.2 mm with respect to chart center
Calibration . . . . . 10 mv internal signal ± 1%
Limiting . . . . . approx. ± 115% of full scale
Rise Time . . . . 4 milliseconds with less than 4% overshoot

physical

Input Connectors . . . . . separate for each channel
Output Connectors . . . . 40 mv/mm sensitivity for connection of external monitoring scope to each channel
Dimensions . . . . . approx. 12¾" by 12¾" by 8¾"
Weight . . . . . approx. 55 lbs.

Controls
(for each recording channel)
Range Switch . . . . . 6 positions and off
Smooth Gain Control
Function Switch . . . . 4 positions — Zero, Cal, Use mv/mm Use v/cm
Position Control
Stylus Heat Control

Galvanometer Damping
Galvanometer Compensation (screwdriver adjusts.)

(for the entire system)
Power ON-OFF
Speed Control . . . . . 1, 5, 20, and 100 mm/sec
Marker-Off-Timer

Data subject to change without notice.

See this new System at the I.R.E. Show—Booths 3601—03—05

SANBORN COMPANY
INDUSTRIAL DIVISION 175 Wyman Street, Waltham, Massachusetts

CIRCLE 117 ON READER SERVICE CARD

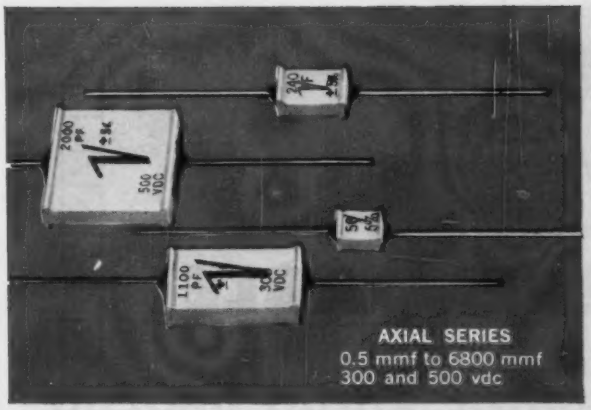
Transistor-regulated Power Supplies for critical Commercial and Military applications

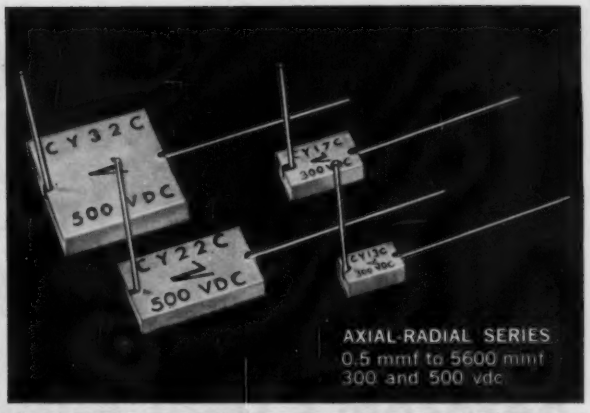
Now, first time ever . . . Power Sources, Inc., presents units backed by a full 5-year (all components-included) warranty! New low prices on LOW VOLTAGE POWER SUPPLIES featuring outputs of 6-36 volts, current ranges from 5-30 amps. HIGH VOLTAGE POWER SUPPLIES at the lowest prices ever for precision transistor-regulated supplies in this power and voltage range (30-330 volts, to 1.5 amps). Half the size, half the weight of comparable tube-type supplies. BOTH LINES fully short-circuit protected, 15″ deep to fit standard 19″ racks, and guaranteed to meet published specs. Note: all units available with meters at slight extra cost.

Specifications	Low Voltage			High Voltage			
	Model PS4305	Model PS4315	Model PS4330	Model PS4221	Model PS4231	Model PS4222	Model PS4232
Voltage Range (VDC)	6-36	6-36	6-36	30-210	120-330	30-210	120-330
Current Range (Amps)	0-5	0-15	0-30	0-.8	0-.8	0-1.5	0-1.5
Regulation Against 10% Line change 0 to full load	.025% .025%	.025% .025%	.025% .025%	0.1% 0.1%	0.1% 0.1%	0.1% 0.1%	0.1% 0.1%
Impedance (Ohms) DC to 100KC	.1	.02	.02	.4	.4	.2	.2
Ripple (RMS) in Millivolts	1	1	1	2	3	2	3
Panel Height	5¼″	5¼″	8¾″	5¼″	5¼″	5¼″	5¼″

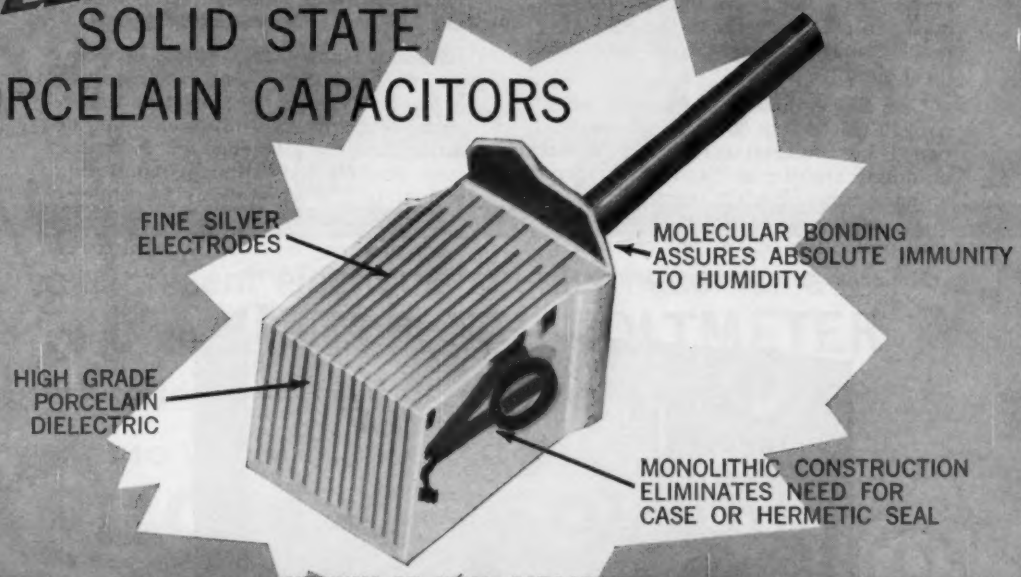
Write for complete specifications

Specify POWER SOURCES BY
POWER SOURCES, INC.
BURLINGTON, MASSACHUSETTS

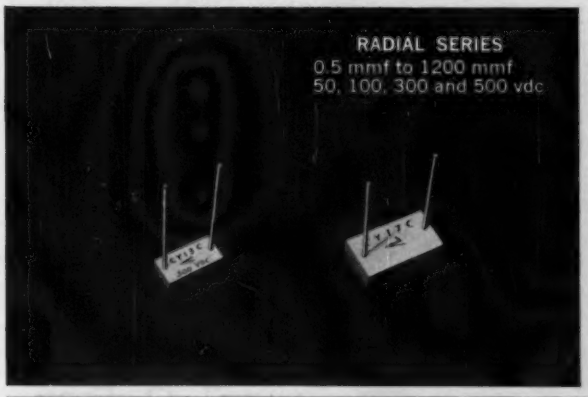




Vitramon®
SOLID STATE PORCELAIN CAPACITORS


FINE SILVER ELECTRODES
MOLECULAR BONDING ASSURES ABSOLUTE IMMUNITY TO HUMIDITY
HIGH GRADE PORCELAIN DIELECTRIC
MONOLITHIC CONSTRUCTION ELIMINATES NEED FOR CASE OR HERMETIC SEAL

CUTAWAY OF AXIAL CAPACITOR



SOLID-STATE RELIABILITY MAKES THE DIFFERENCE

The exclusive "Vitramon" Process fuses fine silver electrodes within a solid block of dense dielectric porcelain to form an integral monolithic unit with outstanding electrical and physical properties.

The molecular bond of dielectric, electrodes and terminals assures absolute immunity to humidity, low loss, low noise and great stability over a temperature range of —55°C to 200°C.

True reliability is inherent in the solid-state construction of all "Vitramon" porcelain capacitors. They are used extensively where quality, precision and dependability are imperatives.

VITRAMON® INCORPORATED
P. O. Box 544 • Bridgeport 1, Connecticut

AER -O- COM

DEFINITELY DEPENDABLE!

Aerocom's Dual Automatic Radio Beacon

Reliability is built into every part of this dual 1000-watt aerophare unit. Ruggedly constructed and conservatively rated, it provides trouble-free unattended service, and at truly low operating and maintenance cost. It operates in the frequency range 200-415 kcs, using plug-in crystal for desired frequency.

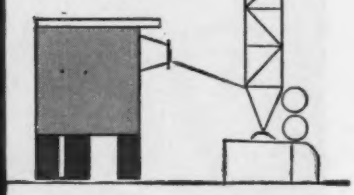
Uses single phase power supply, nominal 220 volts, 50 or 60 cycles. Consists of two 1 kw transmitters with 2 keyers, automatic transfer unit and weatherproof antenna tuner. Each transmitter housed in separate fan ventilated rack cabinet, with controls in center rack cabinet.

Nominal carrier power is 1000 watts. High level plate modulation of final amplifier is used, providing any desired level of modulation up to 100%. P-T switch interrupts tone, permitting voice operation. Operates in ambient temperatures from –35°C to 55°C, humidity up to 95%.

Standby transmitter is placed in operation when main transmitter suffers loss (or low level) of carrier power or modulation, or continuous (30 sec.) tone, or carrier frequency change of 5 kcs or more. Audible indication in monitoring receiver tells when standby transmitter is in operation.

Antenna may be either vertical tower or symmetrical T type.

Also available in
50 WATT
100 WATT
400 WATT
and
4 KILOWATT
models



A-901

AER -O- COM

3090 S.W. 37th AVENUE · MIAMI, FLORIDA

See demonstration of latest instrumentation techniques at Dymec, I.R.E. Show, Booths 3019, 3020

Now your present electronic counter becomes a really good, accurate **DIGITAL VOLTMETER** by simply adding this self-contained, inexpensive

dy

2210 Voltage-to-Frequency

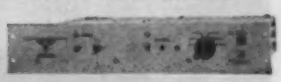
CONVERTER

Now it is simplicity itself to read voltages in direct digital form using your present electronic counter and this new Dymec DY-2210 Converter. You can also measure the time integral of fluctuating voltages directly in volt-seconds — no more tedious, costly manual data reduction and analysis. Unique design principle of the DY-2210 makes it insensitive to most kinds of noise on the input signal.

The DY-2210 generates pulses at a rate accurately proportional to the dc input voltage. Zero input produces zero output cycles, 1 volt produces 10,000 cps. A front-panel attenuator provides additional input ranges of 10 v, 100 v and 1000 v. Positive or negative inputs sensed automatically. Models available for ac inputs and remote programming applications. Price: $660 cabinet, $650 rack-mount.

For details and demonstration, see your Dymec/Hewlett-Packard representative or write direct.

RACK MODEL, PANEL HEIGHT ONLY 3½"



DYMEC A DIVISION OF HEWLETT-PACKARD CO.

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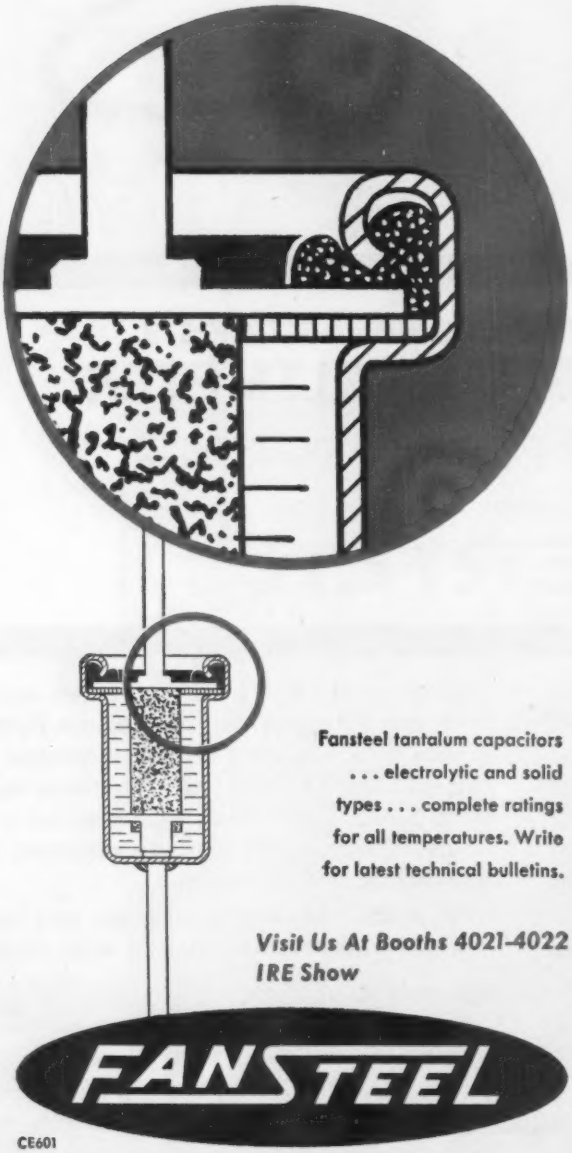
Dymec/dy field representatives in all principal areas

Here's Why

The ORIGINAL Tantalum Capacitor Is Still The Best . . .



Over 10 years of laboratory testing and millions of applications in the field prove that Fansteel's patented shoulder and curl design provides *the best method of sealing* a tantalum electrolytic capacitor.

. . . because the shoulder and curl design of the silver case results in a spring action on the seal assembly at all times.

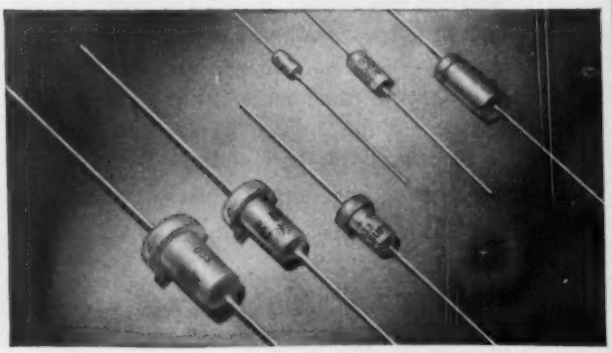
. . . because this downward pressure and tension remains constant throughout the capacitor's temperature range.

. . . because two gaskets—one above, one below the tantalum disk—create an air space, the only effective barrier against capillary action.

. . . because part of the upper gasket is formed into the curl for a perfect seal between case and gasket unaffected by varying temperatures.

. . . because all gasket materials are carefully selected and controlled in their parameters so as not to interfere with the curl's spring action.

. . . because there can be no loosening of the seal due to compression set.



Fansteel tantalum capacitors . . . electrolytic and solid types . . . complete ratings for all temperatures. Write for latest technical bulletins.

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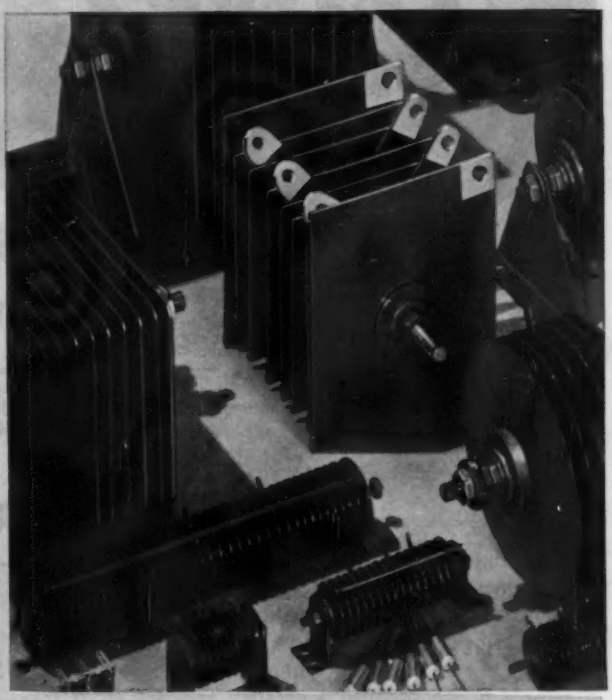
FANSTEEL

CE601

Fansteel Rectifiers

SELENIUM



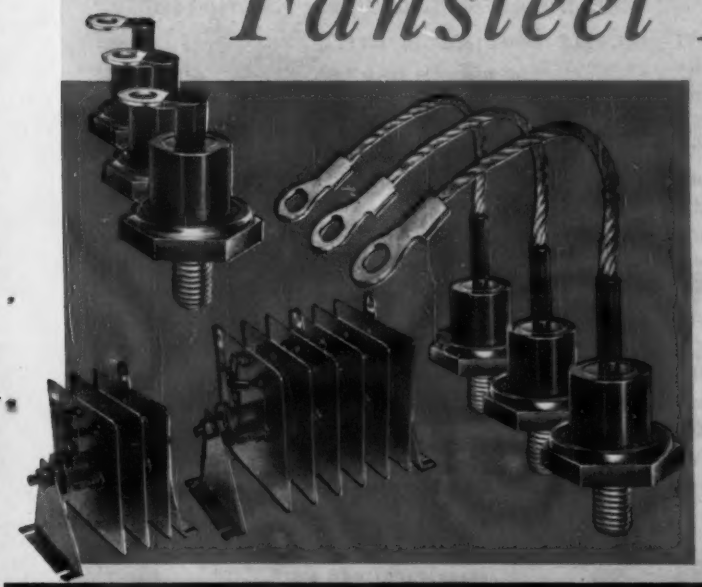
. . . products of almost 30 years of Fansteel research and development in adapting selenium to rectifiers and perfecting cell designs that are now standards for industry.

Fansteel Selenium Rectifiers offer practically unlimited life with no maintenance. Instantaneous power with negligible leakage. Over 400,000 different stack combinations readily available in almost unlimited power ratings, any standard cell size or circuit.

Fansteel selenium cells are produced in dust-free, conditioned-air surroundings and undergo rigid testing for workmanship, performance and reliability.

Fansteel Rectifiers

SILICON



...d-c power sources for all applications requiring highest reliability under severe service conditions. Produced under exacting "white room" conditions using finest-quality materials. Thorough, 100% testing assures peak performance.

22 amp., 35 amp. and 75 amp. types, 1N Series, Individual or in stack assemblies with bridge, center tap or doubler circuits.

Write for Bulletins

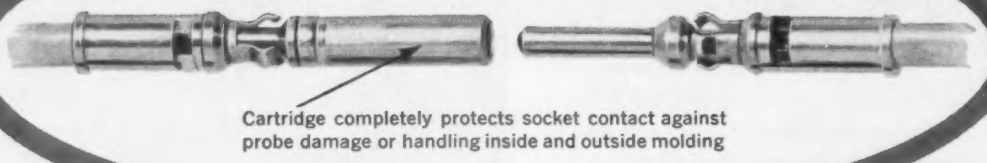
FANSTEEL METALLURGICAL CORPORATION
North Chicago, Ill., U.S.A.

FANSTEEL RELIABILITY

New! REMOVABLE CONTACT

BY CONTINENTAL CONNECTORS

ENLARGED VIEW TO SHOW DETAIL



Cartridge completely protects socket contact against probe damage or handling inside and outside molding

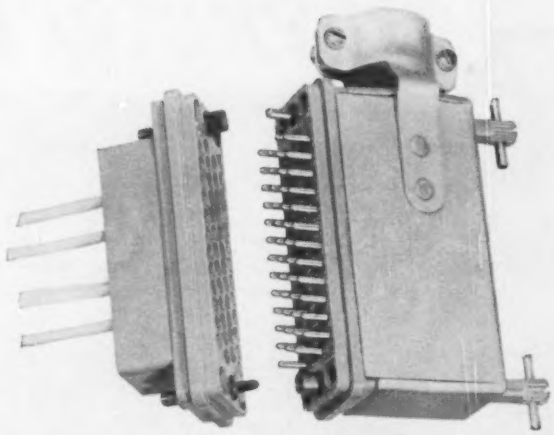
Eliminate all connector soldering operations with Continental Connector's new, improved removable contact with crimp terminations. Extra wide, three-tine spring clutch on pin and socket provides maximum holding area between contact and molded block. Contacts are supplied separately and are wired independently. This permits mounting of plug and socket connector units at any convenient time without waiting for completion of wiring operation.

Wire crimping is fast and easy with hand or power crimping tools readily available for small or quantity production. Contacts are quickly removed and replaced with a simple, low cost hand tool.

These removable contacts are designed for use with Continental Series 25 Miniature Rectangular Connectors in sizes of 14, 26, 34, 50, 75 and 104 contacts. Both socket and pin contacts are made of phosphor bronze with gold plate over silver plate. Terminations accommodate any #16 to #22 AWG wire. Removable contact connectors are interchangeable with existing fixed contact types.

For complete technical data bulletin on Continental Removable Contact Connectors, write to Electronics Division, DeJUR-AMSCO CORPORATION, 45-01 Northern Boulevard, Long Island City 1, N. Y. (Exclusive Sales Agent.)

Closed Entry Cartridge For Miniature Rectangular Connectors



Series 25 plug and socket connector with removable contacts and patented polarizing screwlocks. Plug is illustrated with side opening aluminum hood.

CONTINENTAL CONNECTORS

MANUFACTURED BY
CONTINENTAL CONNECTOR CORPORATION,
AMERICA'S FASTEST GROWING LINE OF
PRECISION CONNECTORS

SEE US AT THE IRE SHOW . . . BOOTHS 2307-2309

124 CIRCLE 124 ON READER SERVICE CARD

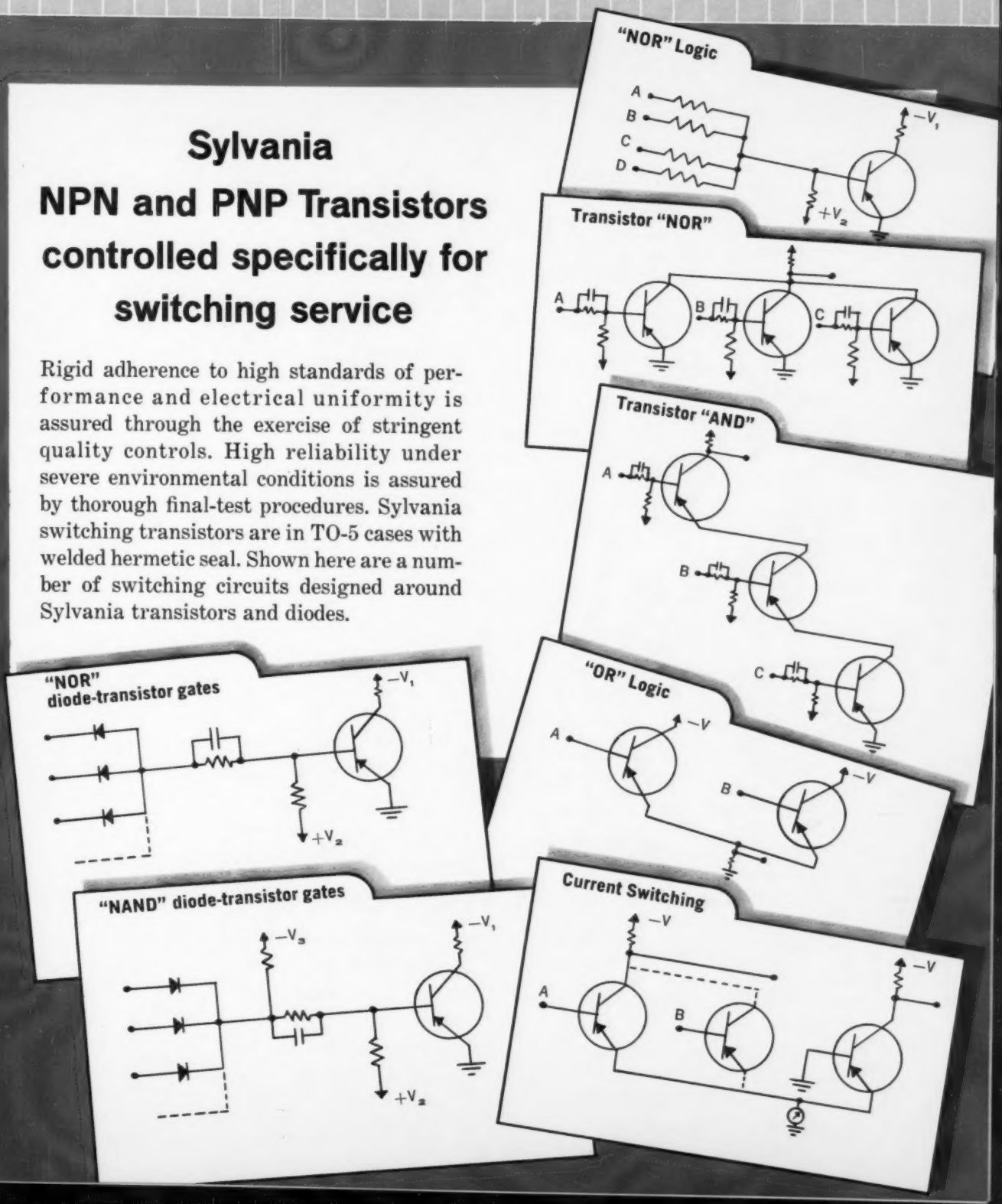
CIRCLE 125 ON READER SERVICE CARD 125→

Semiconductor News

from SYLVANIA Quality-by intention!

Sylvania
NPN and PNP Transistors controlled specifically for switching service

Rigid adherence to high standards of performance and electrical uniformity is assured through the exercise of stringent quality controls. High reliability under severe environmental conditions is assured by thorough final-test procedures. Sylvania switching transistors are in TO-5 cases with welded hermetic seal. Shown here are a number of switching circuits designed around Sylvania transistors and diodes.



SYLVANIA NPN AND PNP SWITCHING TRANSISTORS

Reliable performers in military and computer applications

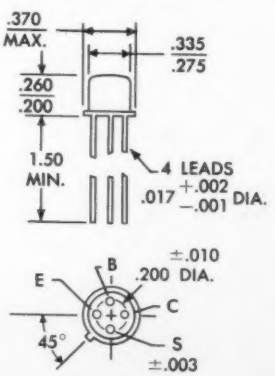
ELECTRICAL CHARACTERISTICS

NPN Type	COLLECTOR TO BASE VOLTS (Min.)	EMITTER TO BASE VOLTS (Min.)	POWER DISS. AT 25°C (Max.)	FREQ. CUTOFF, FAB V_{CB}=6v. 1c=1ma (Min.)
2N312	15V	15V	100mW	3.0Mc
2N356	20V	20V	100mW	3.0Mc
2N357	20V	20V	100mW	6.0Mc
2N358	20V	20V	100mW	–
2N377	25V	15V	150mW	2.5Mc
2N377A	40V	15V	200mW	2.5Mc
2N385	25V	15V	150mW	4.0Mc
2N385A	40V	15V	200mW	4.0Mc
2N388	25V	15V	150mW	5.0Mc
2N388A	40V	15V	200mW	5.0Mc
2N438	30V	25V	100mW	2.5Mc
2N438A	30V	25V	150mW	2.5Mc
2N439	30V	25V	100mW	5.0Mc
2N439A	30V	25V	150mW	5.0Mc
2N440	30V	25V	100mW	10.0Mc
2N440A	30V	25V	150mW	10.0Mc
2N556	25V	10V	100mW	–
2N557	20V	10V	100mW	–
2N558	15V	5V	100mW	–
2N576	20V	15V	200mW	5.0Mc
2N576A	40V	15V	200mW	5.0Mc
2N585	25V	20V	120mW	3.0Mc
2N587	40V	40V	150mW	–
2N679	25V	15V	150mW	2.0Mc
2N1302	25V	25V	150mW	3.0Mc
2N1304	25V	25V	150mW	5.0Mc
2N1306	25V	25V	150mW	10.0Mc
2N1308	25V	25V	150mW	15.0Mc
2N1114	25V	15V	150mW	7.0Mc
2N1299	40V	15V	150mW	4.0Mc

PNP Type	COLLECTOR TO BASE VOLTS (Min.)	EMITTER TO BASE VOLTS (Max.)	POWER DISS. AT 25°C (Max.)	FREQ. CUTOFF, FAB V_{CB}=5 1e=1mA (Min.)
2N123	–20V	–10V	150mW	5.0Mc
2N404	–25V	–12V	150mW	4.0Mc
2N414	–30V	–12V	150mW	5.0Mc
2N425	–30V	–20V	150mW	2.5Mc
2N426	–30V	–20V	150mW	3.0Mc
2N427	–30V	–20V	150mW	5.0Mc
2N428	–30V	–20V	150mW	10.0Mc
2N519	–25V	–15V	150mW	0.5Mc
2N582	–25V	–12V	150mW	14.0Mc
2N1009	–10V	–	120mW	0.5Mc
2N1381	–25V	–15V	150mW	0.5Mc

SYLVANIA 2N624 "DRIFT" TRANSISTOR FOR TUNED-AMPLIFIER SERVICE TO 12.5 MC

Sylvania 2N624 is a hermetically sealed PNP diffused-base transistor. The package has JEDEC TO-12 dimensions and lead spacings. A fourth lead provides a connection to the metal case for improved shielding. Characteristic testing includes many environmental parameters to assure reliable operation under conditions which may be expected in military applications. Sylvania 2N624 conforms to the requirements for military electronics equipment.



SYLVANIA DIODES Sylvania manufactures all types of diodes for service as gates, clippers, clampers, detectors; diodes for applications in communications equipment, switching circuits in electronic computers operating at high speeds in the order of millimicroseconds, and special-purpose electronic devices.

SYLVANIA facilities for life and environmental testing include salt spray, moisture, high altitude, vibration, shock, high and low temperatures. SYLVANIA manufacturing and testing facilities are highly automated and mechanized to assure extraordinary electrical uniformity. Many SYLVANIA diodes are available with specifications conforming to military requirements.

POINT-CONTACT DIODES

feature low cost, low capacitance, and exceptionally fast recovery time. Available in all-glass "min" package with power dissipation capabilities to 80mW. Available in solder-seal package for wire-in or clip-in use with power dissipation capabilities to 225mW.

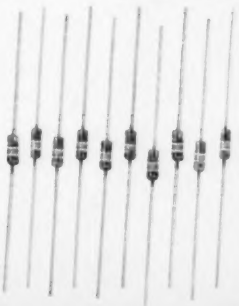
GOLD BOND DIODES

feature high forward-conduction and good recovery-time in units that are relatively low in cost. Available in all-glass "min" package with power dissipation capabilities averaging 80mW.

VLI (very low impedance) DIODES

feature very high conduction and relatively high voltage-breakdown. Available in all-glass "min" package with power dissipation capabilities averaging 80mW. Available in solder-seal package for wire-in or clip-in use with increased power dissipation capabilities to 225mW.

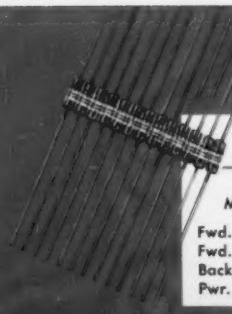
SILICON-JUNCTION DIODES



feature high conduction, good recovery time plus the environmental capabilities of silicon—the ability to withstand wide variations in ambient temperature. Available in all-glass "min" package with power dissipation capabilities to 200mW.

SYLVANIA D-1820 HIGH-SPEED SWITCHING DIODE

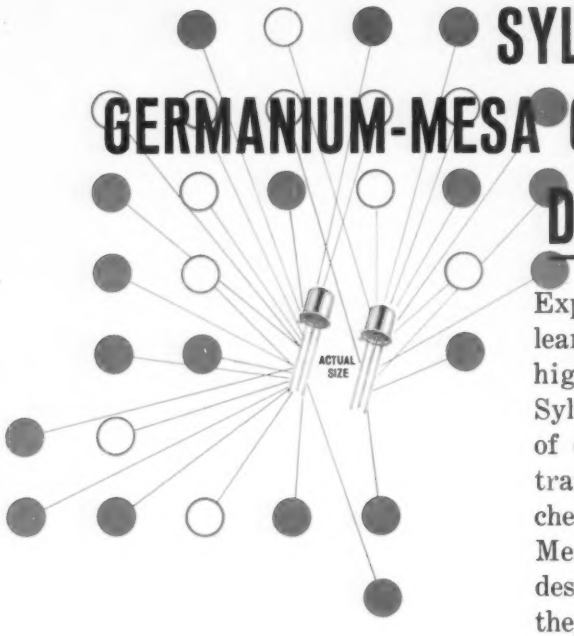
4 millimicroseconds guaranteed maximum recovery time!



ELECTRICAL CHARACTERISTICS—SYLVANIA D-1820

Absolute Maximum Ratings*		Typical Operating Conditions*	
Fwd. Volt	1.3 V †	Fwd. Volt	0.9 V
Fwd. Curr.	50 mA	Fwd. Curr.	2.0 μA
Back Volt	20 V	Rev. Recovery	2.5 mμs
Pwr. Diss.	80 mW		

SYLVANIA D-1820—now available in commercial quantities—is designed, produced and controlled specifically for logic circuitry. The cost of this SYLVANIA diode is low enough to make it especially attractive for use in quantity-produced electronic computers. SYLVANIA D-1820 and circuits designed around it feature: high-speed operation • long-life performance • high reliability • exceptional uniformity • economy • simplicity • compactness.



SYLVANIA 2N705 and 2N710 GERMANIUM-MESA COMPUTER TRANSISTORS

DEPENDABLE! AVAILABLE!

Experienced designers of electronic computers have learned they can depend on the performance of high-speed switching circuits designed around Sylvania transistors. An exceptionally high degree of dependability is built into SYLVANIA Mesa transistors. There are 31 in-line quality control check-points for SYLVANIA 2N705 and 2N710 Mesa transistors. Another important reason for designing around SYLVANIA 2N705 and 2N710: they are available now.

A COMPREHENSIVE LINE OF SILICON RECTIFIERS

The latest in production equipment plus the most modern test procedures are devoted to the manufacture of SYLVANIA silicon rectifiers. Clinically controlled atmospheres on the production line minimize contaminants, result in units that feature low leakage and promise long-life operation.

SYLVANIA silicon rectifiers are quality-controlled for applications in *industrial power supplies* and *magnetic amplifiers*. SYLVANIA silicon rectifiers are available with peak-inverse-voltage ratings to 1000-Volts, and forward-current ratings to 750-mA.

SYLVANIA—RELIABLE SEMICONDUCTORS TO THE TELEPHONE INDUSTRY!

SYLVANIA semiconductor devices are available from your local franchised SYLVANIA SEMICONDUCTOR DISTRIBUTOR or through the FIELD OFFICE nearest you. For technical data, write: SYLVANIA SEMICONDUCTOR DIVISION, WOBURN, MASSACHUSETTS.

SYLVANIA

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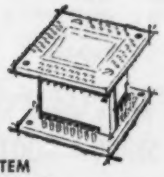
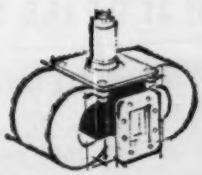
INDOX V ceramic permanent magnet provides high energy level . . . reduces speaker length and weight.

This trademark is the calling card of a new leader in science-age materials — Indiana General Corporation. It is born of a union between two established leaders — The Indiana Steel Products Company in permanent magnets . . . the General Ceramics Company in ferrites and memory systems. Together, as Indiana General Corporation, they serve you better by placing at your disposal the brains and resources of two scientifically oriented concerns. Research and development have been the backbone of both of the original companies; both have records of significant achievement in their particular fields.

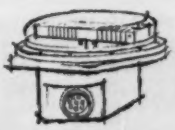
Indiana General can help you "design-engineer" your products with the latest magnetic innovations. If you have a design problem, the Indiana General sales engineer in your area will be most happy to advise you. And, behind him, our experienced scientists and design engineers are available for consultations — at no cost or obligation. Write us outlining your problems.



MEMORY SYSTEM
New microstack unit for coincident current memory systems saves 90% of space required by conventional stack, yet is more reliable.



MAGNETRON
Powerful Hyflux ALNICO V magnets improve performance in many types of microwave equipment.



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Ferramic "E" magnetic core material helped engineers create a new concept in aircraft antenna design.

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I get shortest etching time with HUNT ETCHANTS

HUNT R.C.E. for PRINTED CIRCUIT BOARDS
(Rapid Circuit Etch)

Hunt R. C. E. is a proprietary etchant, formulated to etch printed circuits fast and to speed up production. It offers these 6 big advantages:

- 15% increase in etching speed
- Fast action over entire circuit
- Uniformly smooth etching
- Easily removed by washing
- Substantial increase in capacity
- Freedom from fumes

HUNT SCE for SOLDER-PLATED CIRCUIT BOARDS
(Solder Circuit Etch)

This ready-prepared product is designed to etch solder-plated circuit boards more easily, more effectively than it has ever been done before. You'll find that Hunt S. C. E.

- Etches rapidly at room temperatures
- Has a high capacity for copper
- Never attacks the circuit
- Has guaranteed uniformity, and is of the highest quality because of rigid laboratory control

Hunt S. C. E. is essentially an oxidizing solution with the capacity to keep the oxidized copper permanently in solution. Although many acids will etch copper, S. C. E. solution has the peculiar property of not attacking the solder . . . but giving fast, odorless etching of the copper.

WRITE TO NEAREST HUNT BRANCH FOR:

TECHNICAL BULLETIN NO. 1 — "The Etching of Copper by Hunt R. C. E. Solution."

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manufacturers of a complete variety of standard microwave test equipment and components,

is pleased to announce the addition of a new and complete line of

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TRADE MARK

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which include the following:

adapters	signal samplers	loads	tees
test horns	crystal detector mounts	phase shifters	transitions
attenuators	terminations	slotted lines	tuners
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These units will be supplied in the following EIA designated tubing sizes: WR77, WR975, WR1150, WR1500, WR1800, WR2100, WR2300.

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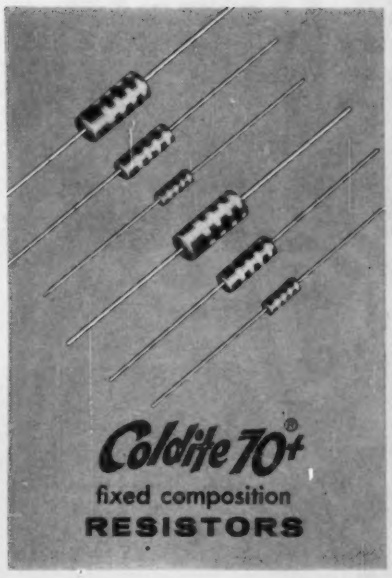

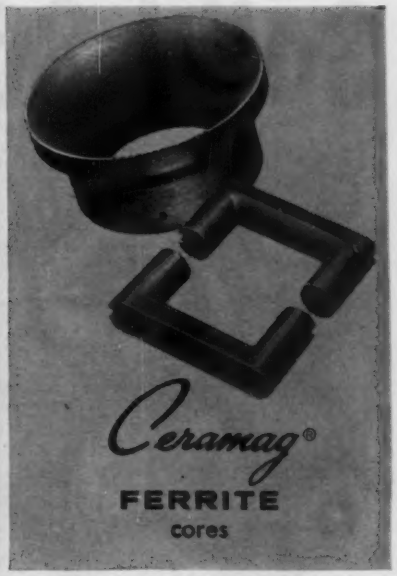

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Electronic Components Division

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Solid State Reliability IN A 10 mc Counter

The CMC 700 Series is the only major breakthrough in counting, timing and frequency measuring equipment in the past 10 years. Here is the first successful application of transistors to high frequency counting and timing. Transistors perform all the functions in CMC's 700 series that required 63 tubes in old style counting equipment. These are the most reliable counters ever made.

TRUE DIGITAL LOGIC CIRCUITRY

By answering an obvious need for a completely new, up-to-date approach to counting and timing instrumentation, CMC has produced solid state instruments with greatly simplified circuitry, using logic "and" and "or" gates.

LIGHT AND SMALL, LOWER POWER DRAIN

Each 700 series instrument weighs only 27 pounds, measures 7 inches high, 17 inches wide, and 14 inches deep. Power consumption is a meager 46 watts, 1/10 the amount for vacuum tube models.

DO ALL THESE JOBS

Measure frequency from dc to 10 mc, time interval from 0.1 μsec, ratio 1 cps to 1 mc and unlimited multiple period selection. Frequency converters available for higher frequencies. The counter also generates time interval marker pulses from 1 μsec to 1 second. Data can be presented on standard decades or inline Nixie tubes. The 700 series will operate digital recording equipment, punches, inline readouts, and other data handling gear.

These Features, Too—Decade count-down time base—frequency divider circuits never need adjustment. Accuracy, ±1 count ±oscillator stability. Sensitivity, 0.25 v rms; input impedance, 25 k ohms/volt.

And The Price—Higher than vacuum tube models. But you can save the difference on down time in the first year. Model 727A Universal Counter-Timer, $2,750; Model 707A Frequency-Period Meter, $2,575; Model 757A Time Interval Meter, $1,975. Rack mount optional at no extra cost. All prices f.o.b. Sylmar, California.

More Information Available – Your nearby CMC engineering representative will be happy to arrange a demonstration and provide you with complete technical information. Or you may write Department 18-3.

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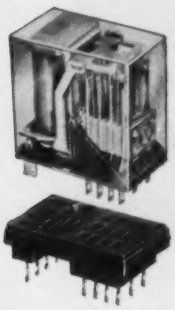
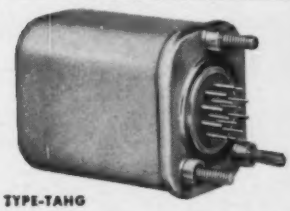
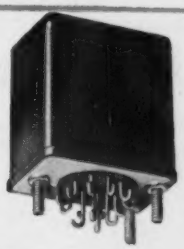


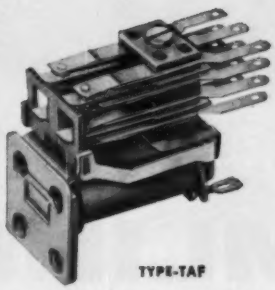
TYPE-T-154
H-1 3/16 ● W-47/64 ● L-1 11/64



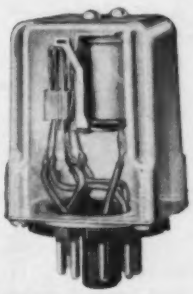
TYPE-TAHG
H-2 3/16 ● W-1 7/16 ● L-1 5/8



TYPE-TAH
H-1 19/32 ● W-61/64 ● L-1 11/32



TYPE-TAF
H-1 17/64 ● W-41/64 ● L-1 5/16



TYPE-TADO
H-2 ● W-1 13/32 ● L-1 13/32

PERFORMANCE CHARACTERISTICS

Contact Arrangement
Up to 12 springs maximum form A, B or C

Contact Rating
2 amperes resistive or 1 ampere inductive at 29 volts d-c or 115 volts a-c
Low level or 5 ampere contacts available on request

Standard Coil Voltages
Suitable coil resistances can be supplied for operation at any voltage within the range of 0.5 to 130 volts d-c

Coil Power
Nominal: 700 milliwatts
Minimum Operate Power: 125 to 300 milliwatts depending on application, contact arrangement and coil resistance.

Timing at Nominal Voltage
Operate time: 15 milliseconds maximum
Release time: 5.0 milliseconds maximum

Vibration
10-55 cps at .062 inch double amplitude
55-500 cps at a constant 10g

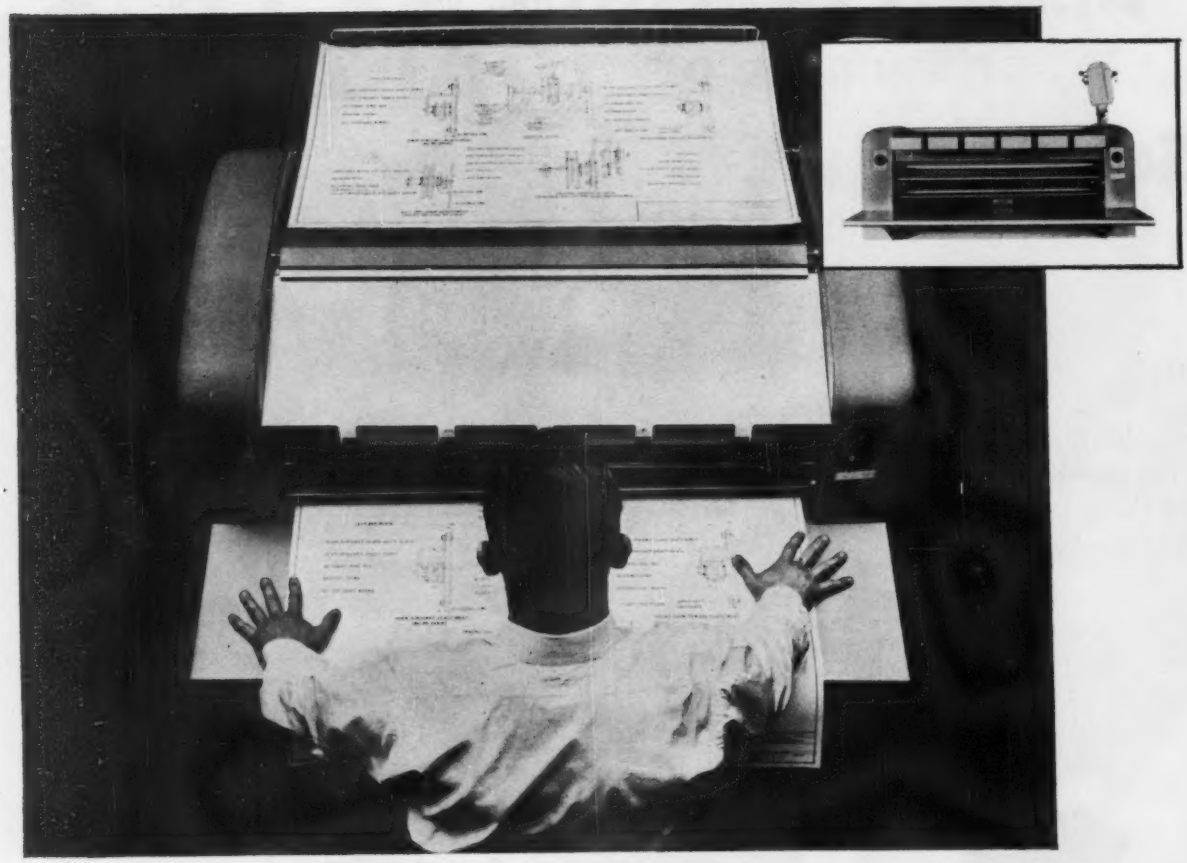
Shock: 25g operational

Enclosure
Open, dust cover or hermetically sealed

Weight
Open type 1.0 ounce maximum
Sealed type 2.0 ounces maximum

ALLIED CONTROL

ALLIED CONTROL COMPANY, INC., 2 EAST END AVENUE, NEW YORK 21, NEW YORK



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Ozalid's new 30-inch
STREAMLINER 100

Now you can have a compact table-top whiteprinter with "big machine" features at a slim-budget price. And you can enjoy the convenience of on-the-spot printmaking round the clock. Make all the prints you need, inexpensively and without delay. There's no make-ready or cleanup . . . anyone can learn to use the 100 in minutes. Check these important features:

- Makes prints up to 30" wide by any length
- Front and rear print stacking
- Simple dry-developing system
- Easy turn-on, turn-off controls
- Smooth-running electronic drive with speeds up to 14 fpm
- Hook-on tracing receiving tray (optional at extra cost)

And the versatile Streamliner 100 handles the whole range of Ozalid sensitized materials . . . lets you turn out gum-backed labels, photographs, cloth maps, or color transparencies!

For complete details on the new Streamliner 100, mail coupon today!

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In Canada: Hughes-Owens Co., Ltd., Montreal

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CIRCLE 135 ON READER SERVICE CARD→

"AND HAVING WRIT, MOVES ON*"

Who stands still, falls behind. Fairchild Semiconductor Corporation is devoting considerable effort to building the lead it has achieved in advanced silicon semiconductor devices. We are not unique in our technological abilities; we do have a head start. It is an opportunity and a challenge based in Time.

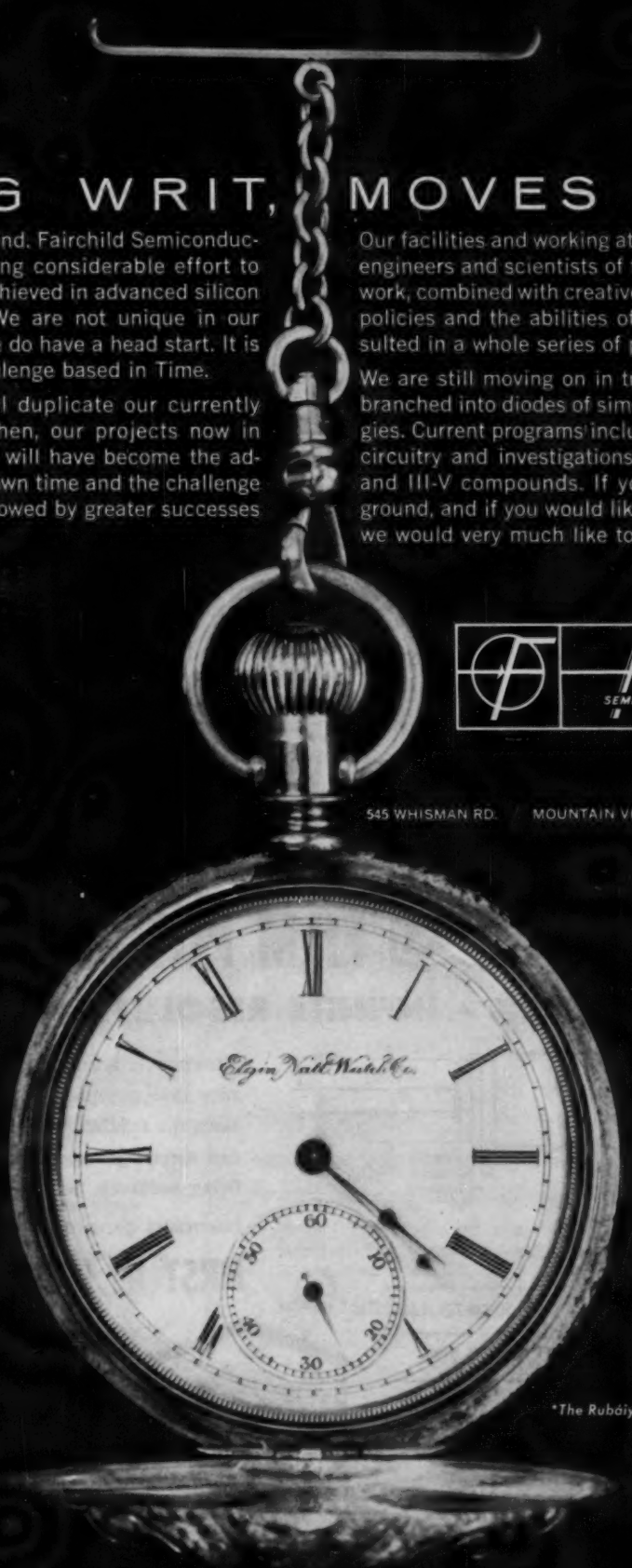
Other manufacturers will duplicate our currently unique transistors. By then, our projects now in Research & Development will have become the advanced products of their own time and the challenge continues. Success is followed by greater successes ... or obsolescence.

Our facilities and working atmosphere have attracted engineers and scientists of the highest caliber. Their work, combined with creatively oriented management policies and the abilities of the entire staff, has resulted in a whole series of product innovations.

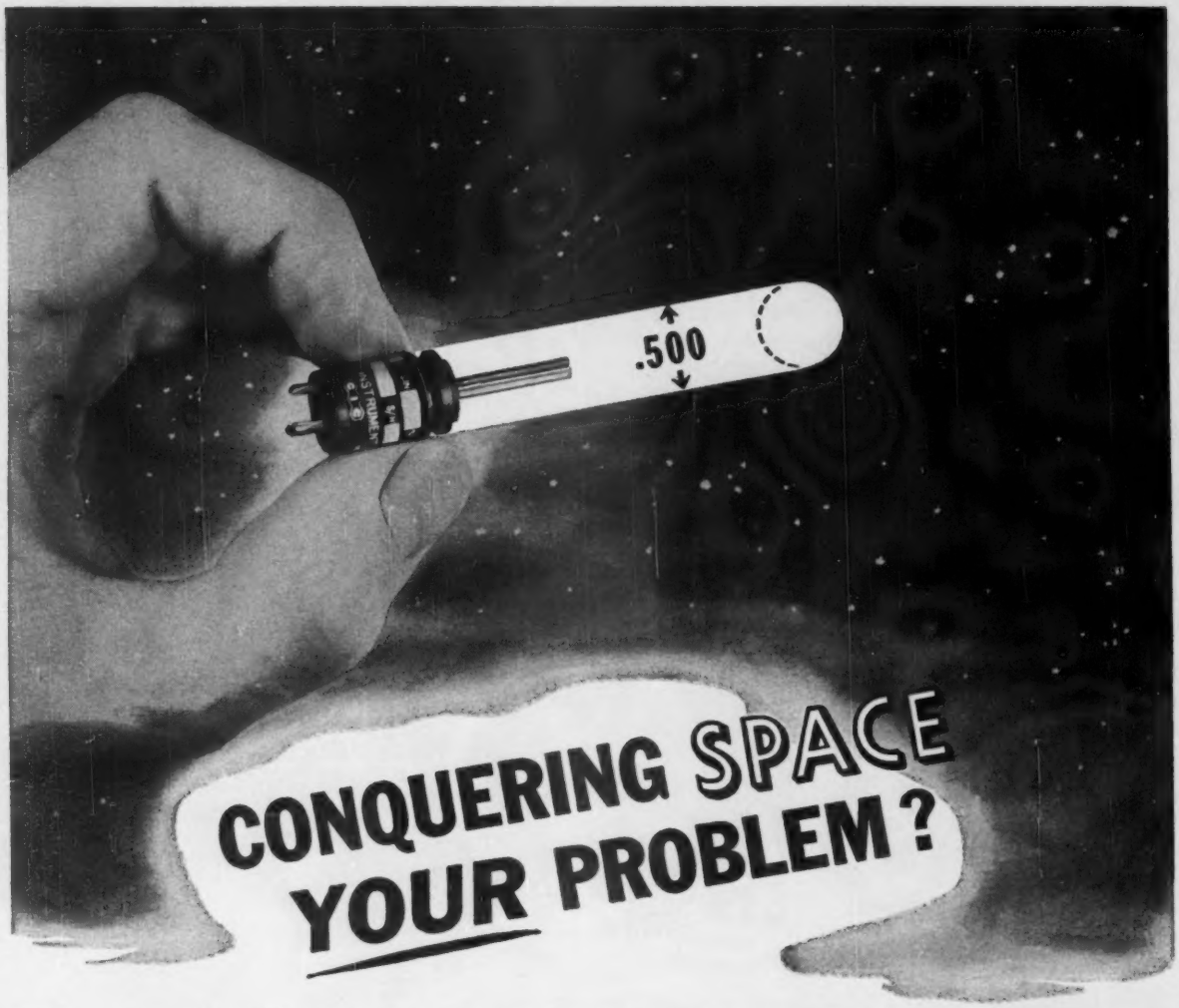
We are still moving on in transistors, and have now branched into diodes of similarly advanced technologies. Current programs include integrated solid-state circuitry and investigations of semiconductor films and III-V compounds. If yours is a relevant background, and if you would like to move ahead with us, we would very much like to hear from you.

FAIRCHILD
SEMICONDUCTOR CORPORATION

545 WHISMAN RD. / MOUNTAIN VIEW, CALIF. / YORKSHIRE 8-8161

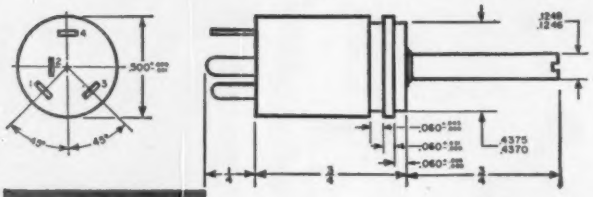


*The Rubáiyát of Omar Khayyám



The NEW 1/2" CIC FILM POT IS THE ANSWER

LINEARITY 0.2% • INFINITE RESOLUTION • LONG LIFE



This subminiature film pot has much greater accuracy than comparable wire-wound types and features the reliability inherent in film pots. Now you can meet tight space requirements without sacrificing accuracy. Send us your specifications.

TERRITORIES OPEN FOR QUALIFIED SALES REPRESENTATIVES

SPECIFICATIONS:

MODEL	50
RESISTANCE RANGE	500Ω TO 150K
BEST LINEARITY OR CONFORMITY	0.2%
WATTAGE	1
GUARANTEED LIFE, REVS.	TO 30×10^6

FIRST IN FILM POTS

COMPUTER INSTRUMENTS CORPORATION

92 Madison Avenue, Hempstead, L. I., N. Y.

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NEW UNIVERSAL SPECTRUM ANALYZER

Polarad Model SA-84W being used to make pulse analysis of radar aboard a Pan American Boeing 707, Jet Clipper®

MODEL SA-84W 10 to 44,000 MC in a single unit

FEATURES:

- **Over 80 mc dispersion**
  1 mc to over 80 mc for narrow pulse analysis.

  100 kc to 7 mc for wide pulse analysis.
- **Dual Resolution**
  7 kc or 50 kc automatically set by dispersion control.
- **Crystal controlled markers from 10 to 44,000 mc.**
- **Provision for use with a multi-pulse spectrum decoder (Polarad Model SD-1)**
- **Log-linear amplifiers**
- **Expanded, direct-reading, slide rule dial.**
- **Accurately calibrated IF attenuator**

The Polarad Model SA-84W is the most accurate universal microwave analyzer to measure nearly all parameters — Pulse, CW, FM, VSWR, antenna patterns, bandwidths and filter characteristics.

FREE LIFETIME SERVICE ON ALL POLARAD INSTRUMENTS

MAIL THIS CARD for specifications. Ask your nearest Polarad representative (in the Yellow Pages) for a copy of "Notes on Microwave Measurements."

POLARAD ELECTRONICS CORPORATION

43-20 34th Street, Long Island City 1, N.Y.
Representatives in principal cities.

POLARAD ELECTRONICS CORPORATION:

Please send me information and specifications on: ME

- ☐ Model SA-84W Universal Spectrum Analyzer
- ☐ Model SD-1 Multi-Pulse Spectrum Selector (see reverse side of page)

POLARAD

My application is_____

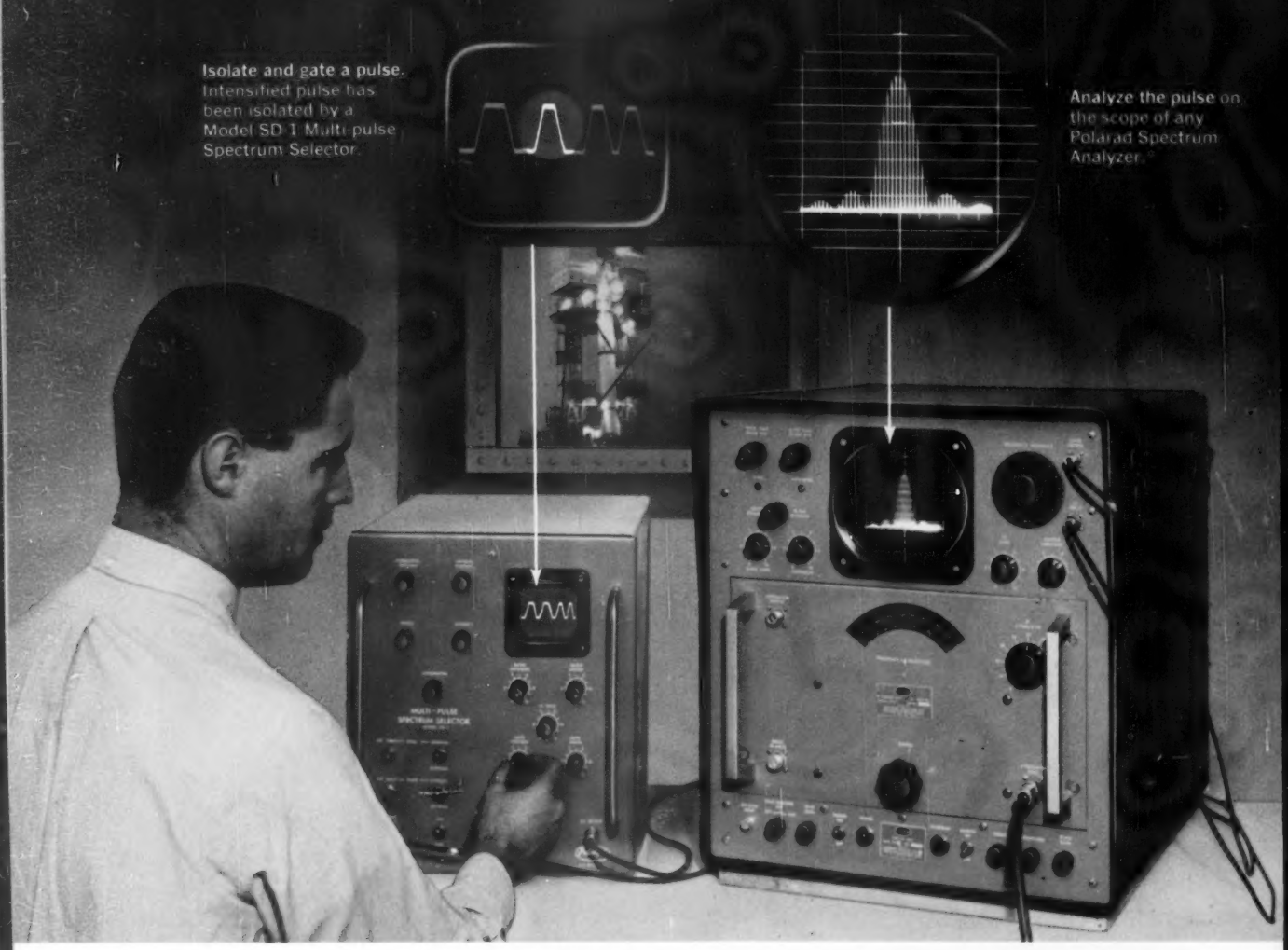
Name_____

Title_____ Dept._____

Company_____

Address_____

City_____ Zone_____ State_____


Isolate and gate a pulse. Intensified pulse has been isolated by a Model SD-1 Multi-pulse Spectrum Selector.
Analyze the pulse on the scope of any Polarad Spectrum Analyzer.

COMPLEX SPECTRUM DECODING

10 to 44,000 mc.

Signal Analysis for Missiles, Telemetry, IFF, Beacons and Radar

The Polarad spectrum selector permits spectrum analysis and decoding of any selected pulse within a multiple pulse train. Sweep, gate width and position can be controlled. Model SD-1 permits the selection and gating of a group of pulses up to 180 μsec. in length (Model SD-IX permits 350 μsec.)

Works with POLARAD Models TSA, TSA-S, TSA-W, SA-84 and SA-84W spectrum analyzers.

Postage Will be Paid by Addressee

No Postage Stamp Necessary If Mailed in the United States.

BUSINESS REPLY CARD
First Class Permit No. 18, Long Island City 1, N.Y.

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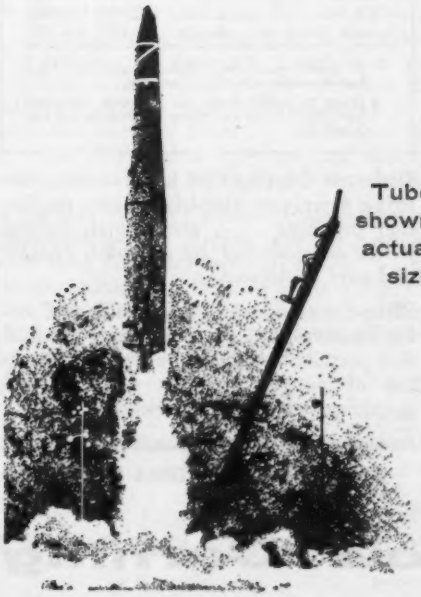
. . . A new subminiature reference tube which is

ABOVE and BEYOND

all present day standards for *stability under shock and thermal extremes*

See us at the IRE Show—Booths 3219 and 3221

For both military and commercial applications which demand a rugged miniature voltage reference tube, the GD85WR-S cannot be matched. This tube has been designed specifically to serve under extreme conditions where standard types fail. It comes to you from BAIRD-ATOMIC, INC., suppliers of world-famous DEKATRON® and DIGITRON cold cathode counting tubes.



Tube shown actual size

TECH TALK

TEMPERATURE RANGE
−60°C to +85°C

SHOCK RATING
Continuously 5G
Short Durations 20G
Impact 750G

STRIKING VOLTAGE
(Total Darkness) 125 v max.

STABILIZED VOLTAGE
85 v ± 2 v

CURRENT RANGE
500 μA to 5.0 mA

INCREMENTAL RESISTANCE
<1000 Ω max.

For more complete data, write today to:

Baird® Atomic

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33 University Road
Cambridge 38, Massachusetts

←CIRCLE 138 ON READER SERVICE CARD

CIRCLE 139 ON READER SERVICE CARD 139

SILICONE NEWS from Dow Corning

NEW: "Solid-State" Fluid

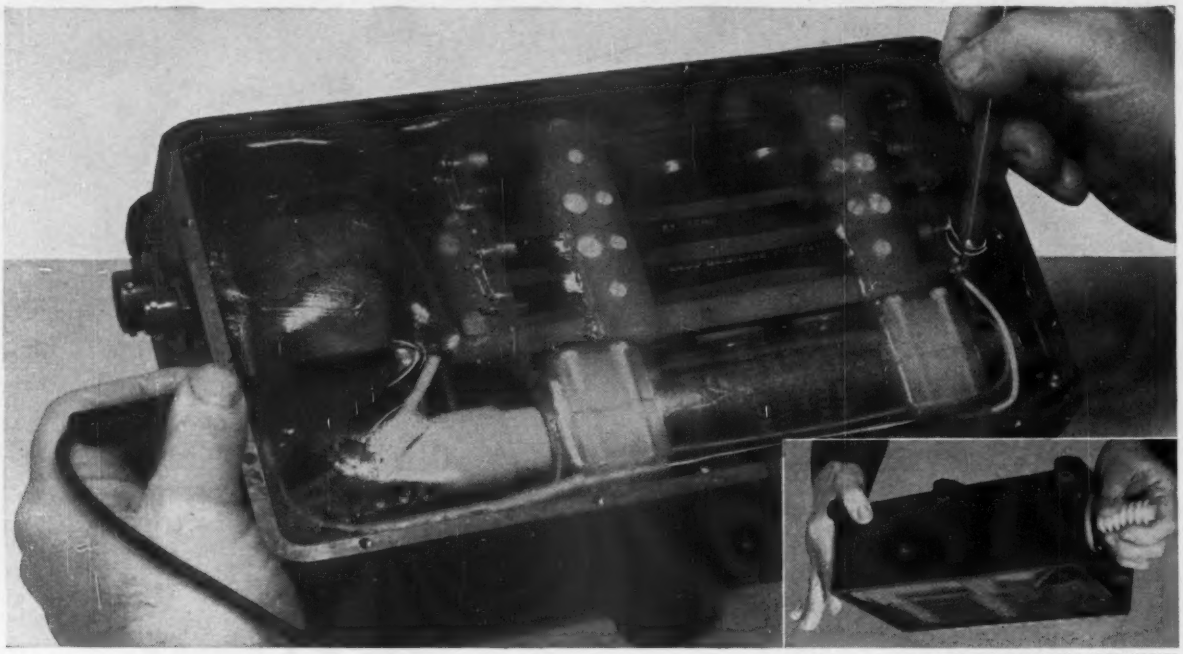


PHOTO COURTESY CBS LABORATORIES

Now: Potted Protection Plus Visual & Instrument Checking

The newest development in potting and encapsulating materials is Dow Corning Dielectric Gel. Supplied as a crystal clear fluid plus catalyst, it pours easily into assemblies and sub-assemblies, fills every void, sets up to a firm, pliable, transparent gel. The gelled mass exerts virtually no stress on components; has excellent adhesion; will not displace if vibrated or inverted. Potted components and connections are visible, probes can be inserted through it for instrument checking. When probes are removed, the gel heals itself, leaving no voids.

Here's how Dielectric Gel aids miniaturization: When designing the high voltage power supply for their new Photoscan airborne reconnaissance system, CBS Laboratories Division of Columbia Broadcasting System Inc., had to meet stringent reliability requirements despite elevated temperatures, high vibration levels, severe size and weight limitations. Their new design and miniaturization techniques were made possible by Dielectric Gel.

Requiring only 0.09 cubic feet complete, with components spaced less than ¼" apart without danger of arcing, the new power supply provides output voltages that can be regulated from 1,000 to 25,000 volts. Current capacity at 25 kv is well over 100 microamperes. This power supply is an integral part of Photoscan, a universal visual intelligence-gathering, processing and transmitting system which can readily be installed in virtually any missile or air-borne vehicle. The units are small, light in weight, simple to install and service.

PROPERTIES OF CURED DIELECTRIC GEL

Color	Water	White
Specific Gravity at 25 C		0.970
Coefficient of Thermal Conductivity:		
(cal per cm °C sec) 150 C		0.00070
200 C		0.00078
Electric Strength*, volts per mil		800
Dielectric Constant†	23 C	150 C
100 cps - 0.1 Mcs	3.0	2.6
Dissipation Factor†		
100 cps	0.0005	0.002
1.0 kc	0.0005	0.0005
0.1 Mcs	0.0001	0.0001
Volume Resistivity†, ohm-cm	1×10^{15}	1×10^{14}

* 60 cycles, rapid rise, 0.020 inch-spacing of 0.5 inch-diameter spherical electrodes.

† Using 54 mmfd fixed air capacitor, Cardwell type, ER-50-FS as electrodes, ASTM D150-54T and D1169-52T.

Dielectric Gel, plus CBS Laboratories packaging techniques simplify volume production problems . . . assure high voltage power supplies that are compact, reliable and easy to service.

Write for more information on Dow Corning Dielectric Gel, the new potting material that permits visual and instrument checking of potted electronic circuitry and simplifies production problems.

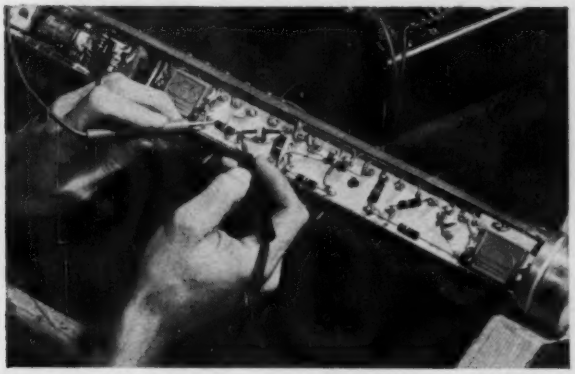
Your nearest Dow Corning office is the number one source for information and technical service on silicones.

first in silicones

CIRCLE 140 ON READER SERVICE CARD

Dow Corning

...other silicones aid miniaturization



Light Silicone-Glass Parts Resist Heat

Where space is small, silicone-glass laminates make ideal parts. Reasons: they resist heat and humidity; are easy to fabricate into miniature components; resist creep and delamination. Silicone-glass laminates are light weight, strong, have good dimensional stability, withstand operating temperatures to 250 C, have low loss factor; permit adjacent soldering and have high resistance to moisture, ozone, arcing and corona.

In the geophysical well-logging instrument shown, Schlumberger Well Surveying Corporation specified terminal boards of silicone-glass laminate. The silicone laminate proved more reliable under operating conditions and easier to fabricate than other materials.

CIRCLE 141 ON READER SERVICE CARD

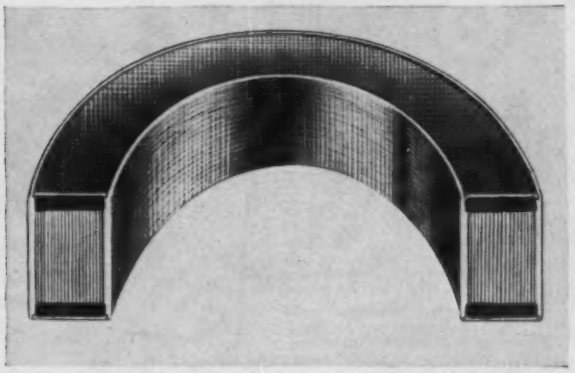
Silastic Assures Reliability Of Miniature Tube

Here's a good example of how miniaturization is aided by Silastic®, the Dow Corning silicone rubber.

A single tube from the line of Beam Switching Tubes developed by the Electronic Tube Division of Burroughs Corporation can replace as many as 90 transistors, diodes and resistors in electronic distributing, switching, and counting circuits. But proper operation and continued reliability depend upon the relationship of crossed magnetic and electrical fields . . . determined by the relative position of the glass envelope and the magnet which surrounds it. This positioning is very critical.

A cushion of Silastic assures proper alignment, bonds the glass envelope and magnet, provides greater shock resistance than any other material tested . . . contributes to the ease with which the tube meets military shock, vibration and other environmental requirements. Easily applied by simple injection techniques, Silastic is also used between magnet and tube shield.

CIRCLE 192 ON READER SERVICE CARD

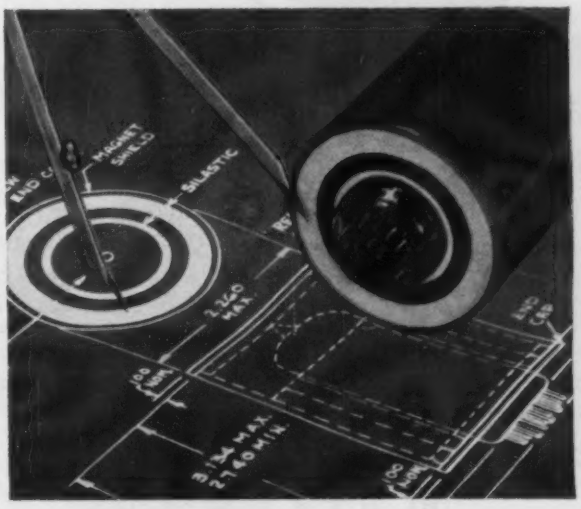


Silicone Compounds Cushion Small Cores

Tape wound toroidal cores, in both miniature and large sizes, are cushioned with silicone compounds between core and outer box by Magnetics Inc. Through the damping effects of the grease-like Dow Corning compounds, their phenolic-boxed cores are protected against vibration, shock effects and strain due to temperature change. They're "performance-guaranteed" up to 177°C.

Dow Corning silicone compounds were selected because they're inert, have high heat resistance and are easily applied. The compounds are nongumming, nonmelting, maintain a stable viscosity from —75 to 200 C. They have excellent dielectric, damping and heat-dissipation qualities, and are superior barriers to moisture. Other firms use silicone compounds for heat-sinks, sealants and similar applications, both mechanical and electrical.

CIRCLE 186 ON READER SERVICE CARD



VISIT BOOTHS 4501-4503 AT IRE SHOW

CORPORATION MIDLAND, MICHIGAN

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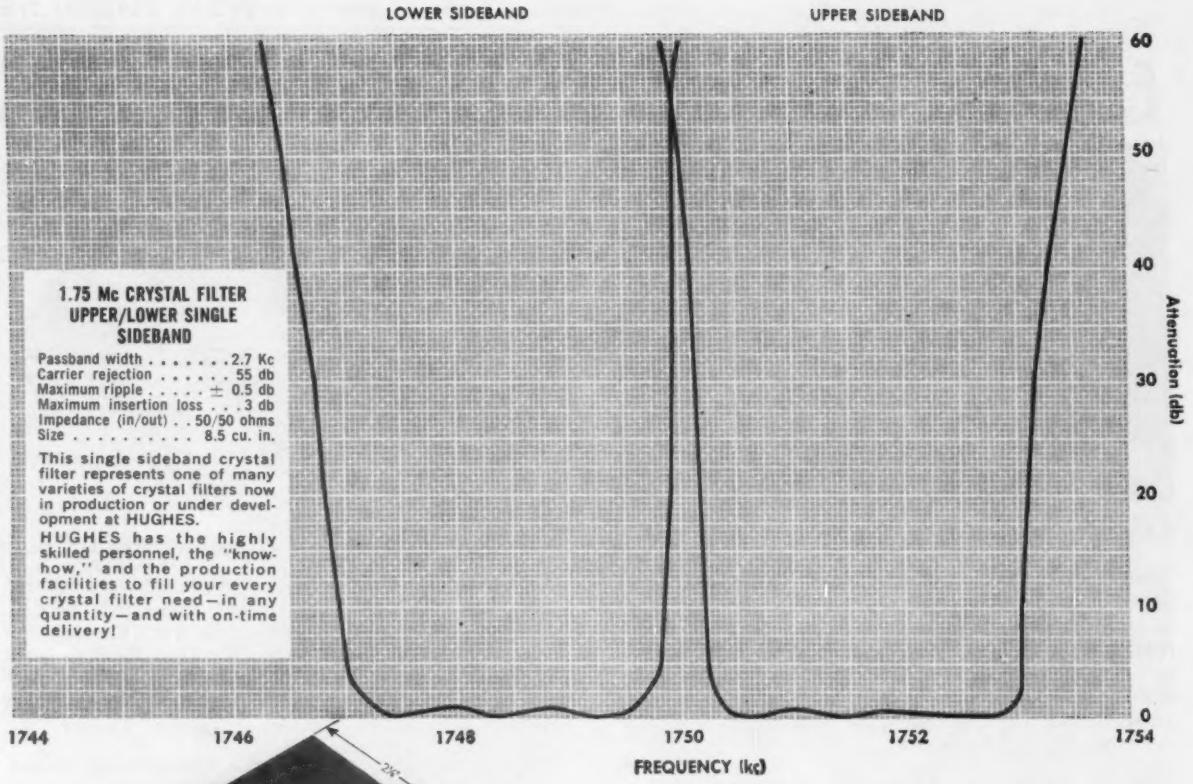
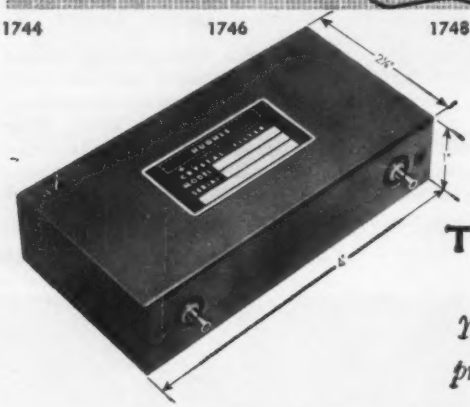


1.75 Mc CRYSTAL FILTER
UPPER/LOWER SINGLE SIDEBAND

Passband width . . . . . 2.7 Kc
Carrier rejection . . . . . 55 db
Maximum ripple . . . . . ± 0.5 db
Maximum insertion loss . . . 3 db
Impedance (in/out) . . 50/50 ohms
Size . . . . . 8.5 cu. in.

This single sideband crystal filter represents one of many varieties of crystal filters now in production or under development at HUGHES.

HUGHES has the highly skilled personnel, the "know-how," and the production facilities to fill your every crystal filter need—in any quantity—and with on-time delivery!



TIGHTEN YOUR "SPECS" WITH HUGHES CRYSTAL FILTERS

Your difficult filtering problems solved with high-performance, precision crystal filters custom-designed and produced for you!

Do you face tough filtering problems in: Single Sideband, Doppler Systems, Missile Guidance, Radio Communications, Radar and Navigation, Spectrum Analyzers, Carrier and Multiplexing, Frequency Shift, High Selectivity Amplifiers?

Check these advantages of Hughes precision crystal filters: Small size, light weight, low insertion loss, low passband ripple, precise selectivity, high frequency filtering, wide temperature stability, high reliability, rugged resistance to shock/vibration, quick delivery in quantity.

Experienced Hughes Application Engineers are available to work with you on your filtering problems. For additional information on crystal filters with center frequencies of 30 kc to 52 mc, and fractional bandwidths of 0.01%-6.0%, write: HUGHES, *Industrial Systems Division, International Airport Station, Los Angeles 45, California.*

For export information, write:
Hughes International,
Culver City, California.

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HUGHES

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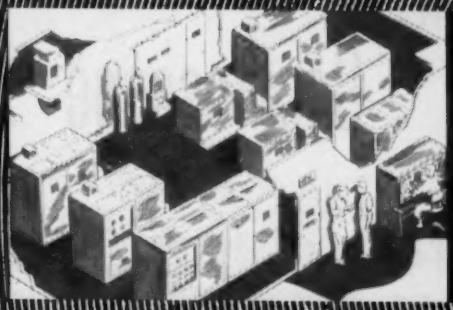
INDUSTRIAL SYSTEMS DIVISION

See Hughes Crystal Filters on display at the Hughes exhibit, I.R.E. Show—Booths 1609-1615.

CIRCLE 143 ON READER SERVICE CARD→

FXR's ENGINEERING KNOW-HOW!



Control room of a 50 million watt tranimitter created to better man's understanding of the atmosphere and ionosphere—The complete transimitter developed and manufactured by FXR.

IRE BOOTH
3713, 15, 17

FXR's precision microwave equipment, high-power pulse modulators and high-voltage power supplies have prominent roles in such leading scientific programs as this 50 million-watt transmitter, thermonuclear control research, communication and ballistic missiles systems and similar astronautical, aeronautical and electronic developments.

50 MILLION-WATTS!

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PRECISION MICROWAVE EQUIPMENT • HIGH-POWER PULSE MODULATORS • HIGH-VOLTAGE PO ER SUPPLIES • ELECTRONIC TEST EQUIPMENT

For more precise measurement of transients

Hughes MEMO-SCOPE® Oscilloscope

The new Hughes MEMO-SCOPE Oscilloscope offers you higher performance, greater dependability and easier operation in all of your transient measurements. Maximum accuracy is assured by new advanced circuitry, new panel layout, new mechanical design and many other added features.

The MEMO-SCOPE Oscilloscope eliminates expensive "hit-or-miss" methods of measuring non-recurring transients. It stores nonrepetitive events for an indefinite period—hours, or days—keeping them available for thorough study until intentionally erased.

For full information on how the MEMO-SCOPE Oscilloscope can help solve your measurement problems, write today to: Hughes, Industrial Systems Division, International Airport Station, Los Angeles 45, California.

For export information, please write: Hughes International, Culver City, California.

Hughes MEMO-SCOPE Oscilloscope: The Hughes MEMO-SCOPE Oscilloscope is one of the most versatile measuring and recording devices available to science and industry today. It is a dual service instrument—for storage or conventional oscilloscopy. Features: *simplified panel layout and carefully designed trigger circuit* for ease of operation; *built-in single sweep ("one-shot") trigger circuit* to avoid cluttered display; *advanced mechanical design* for better cooling and easier maintenance.

New Storage Tube Burn-Out Protection! A circuit designed to protect the delicate storage mesh surface is now incorporated in the Hughes MEMO-SCOPE Oscilloscope. This circuit renders it virtually impossible to burn the storage tube unintentionally as a result of improper operation of the intensity control on the instrument. The intensity control is automatically adjusted by the new protective circuit in the event the operator suddenly switches from the fastest sweep rate to the slowest without decreasing the intensity (an action which formerly might burn the tube), or in the event of similar operational errors.

Hughes Scope Cart: Especially designed for the MEMO-SCOPE Oscilloscope, an all-aluminum scope cart facilitates movement of the instrument to different locations for varied applications. Features: *mounting provisions* for two spare amplifiers, 6' *retractable power cord* for convenience in connecting equipment, ample *drawer space, accessibility* from both sides, pull-out *writing board, full-swivel casters* for ease of movement from one area to another.

Hughes Multitracer Unit: Designed to operate in conjunction with the MEMO-SCOPE Oscilloscope, the portable Hughes Multitracer enables you to store and compare up to 20 stepped-down traces in one display. The stored sweeps appear at equal, preselected intervals forming a raster type of display. The all-electronic Multitracer is a combined attenuator, gate amplifier and storage counter designed to be placed between the signal source and the regular MEMO-SCOPE Oscilloscope input.

Creating a new world with ELECTRONICS

HUGHES

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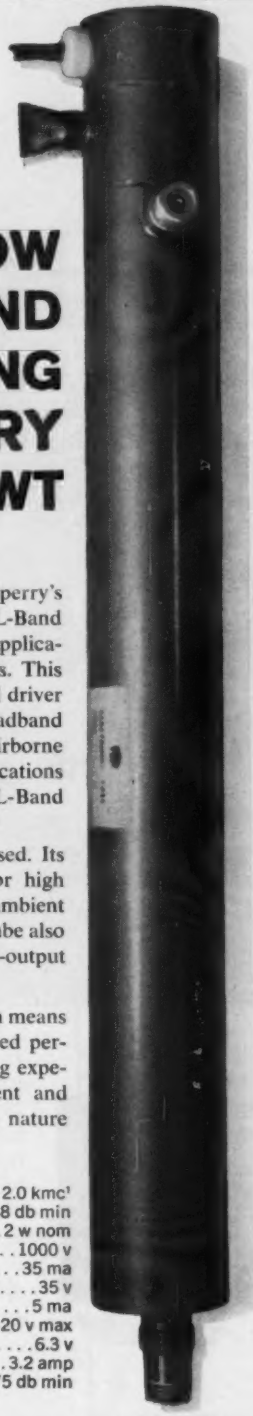
INDUSTRIAL SYSTEMS DIVISION

See the MEMO-SCOPE Oscilloscope in operation at the Hughes exhibit, I.R.E. Show—Booths 1609-1615.

Be Sure To Visit

SPERRY MICROWAVE TUBE CLINIC—IRE SHOW—
March 21-24, Booths # 2432-2438
Bring your problems involving microwave tubes and discuss them with our engineers at this Sperry Clinic.



NOW 60DB GAIN IN L-BAND PPM FOCUSING NEW SPERRY TWT

STL-222

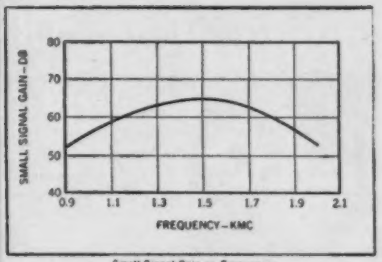
. . . cuts Space, Weight, Cost, Power Requirements — Sperry's new STL-222 provides twice the gain of ordinary L-Band tubes—actually takes the place of two tubes in most applications — yet is only 20" long, weighs only 8.5 pounds. This important advantage suits this new CW amplifier and driver perfectly to airborne applications. Its excellent broadband stability recommends it for ground support and airborne radar equipment . . . communications . . . drone applications . . . noise generators . . . switching devices and other L-Band uses.

The STL-222 is periodic permanent magnet focused. Its tough metal and ceramic construction provides for high environmental capability, stable operation at high ambient temperatures and under extremes of vibration. This tube also features a high-mu modulating grid and high input-to-output isolation. It is short circuit stable.

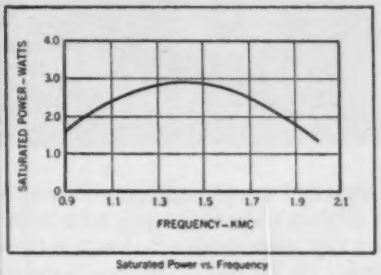
The STL-222 is now in production at Sperry, which means lower unit cost and fast delivery schedules. Advanced performance and dependability result from Sperry's long experience in klystron and TWT research, development and production. Write for complete data, outlining the nature of your application.

Specifications

Frequency Range	1.0 to 2.0 kmc[1]
Small-signal gain	48 db min
Saturated Power Output	2 w nom
Beam Voltage	1000 v
Beam Current	35 ma
Grid Bias	35 v
Grid Current	5 ma
Grid Cut-off Signal	−20 v max
Heater Voltage	6.3 v
Heater Current	3.2 amp
Input-Output Isolation	75 db min



Small-Signal Gain vs. Frequency



Saturated Power vs. Frequency

SPERRY

SPERRY ELECTRONIC TUBE DIVISION, SPERRY RAND CORPORATION, GAINESVILLE, FLORIDA
Address inquiries: Gainesville, or Sperry Offices in Brooklyn • Boston • Philadelphia • Chicago • Los Angeles • Montreal • Export Dept., Great Neck, N.Y.

4 reasons why you should buy Hughes high voltage silicon cartridge rectifiers

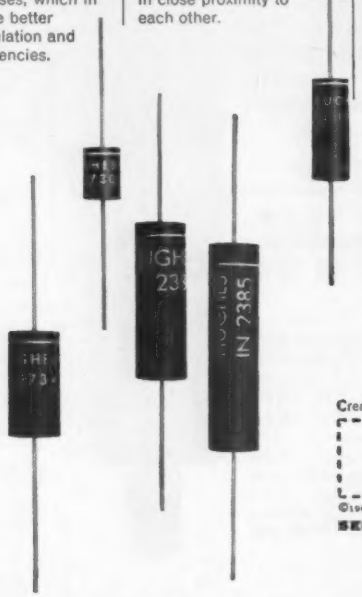
To meet your requirements for IN1730-34, IN2382-85, IN596-98 and IN1406-13 rectifiers... Hughes offers you a universal series with the following advantages over competitive devices:

1 Better High Altitude Performance— Since the case is insulated and provides a long leakage path between leads, the probability of flashover or corona at high altitudes is reduced.

2 Improved Circuit Performance— Fewer diodes are required in each unit to obtain the PIV ratings...thereby lowering losses, which in turn, provide better voltage regulation and higher efficiencies.

3 Savings In Space. The case material is a plastic of high dielectric strength, making it possible to mount units in close proximity to each other.

4 Greater Dependability— These assemblies utilize series strings of Hughes hermetically sealed glass diodes...packaged in a non-combustible cartridge. All internal connections are welded together to insure shock and vibration resistance.



These standard Hughes units are available in voltage ratings from 600 to 10,000 volts. In addition, Hughes offers you many custom assemblies designed to meet your special requirements.

ORDER TODAY! To obtain delivery of Hughes Cartridge Rectifiers just call or write the Hughes Semiconductor Sales Office or Distributor nearest you. Or, for a complete Cartridge Rectifier data sheet (Number: D.S. 82) please write Hughes, Semiconductor Division, Marketing Department, Newport Beach, California.

For export write: Hughes International, Culver City, Calif.

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HUGHES

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SEMICONDUCTOR DIVISION

CDE *Consistently Dependable Capacitors*

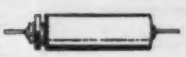
miniaturized pi filters suppress electronic interference from 150 kc to 10,000 mc

C-D *miniaturized* tubular pi filters and 3-terminal feed-thru capacitors suppress electronic interference effectively at any frequency from 150 kc to 10,000 mc. Regardless of your design requirements, the C-D Filter Laboratories can supply you with the exact suppression component you need with tubular shapes, neck-mounting designs and smallest possible case sizes to save space and weight, enable easy installation. C-D miniaturized pi filters and feed-thru capacitors also provide better insertion loss per unit volume, weight and cost as compared to other types of suppression devices at identical ratings.

To obtain complete engineering data and specifications, write for Engineering Bulletins 171, 172 and 166 to Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey. *Manufacturers of consistently dependable capacitors, filters and networks for electronics, thermonucleonics, broadcasting and utility use for 50 years.*

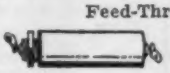
SPECIFICATIONS

Tubular Pi Filter TYPE NFR113



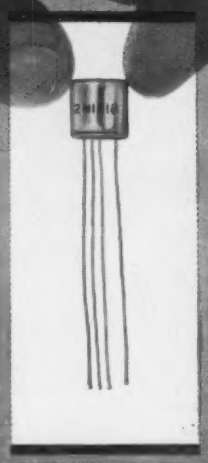
Voltage: 120 VAC (60 cycles), 300 VDC
Current: 0.5 Amperes
Dimensions: 1" x 2 1/16" Weight: 4.0 oz.

Feed-Through Capacitor TYPE NFT5W4P22W



Voltage: 125 VAC (60 cycles), 400 VDC
Current: 25.0 Amperes
Capacitance: 0.22 mfd.
Dimensions: 9/16" x 1 25/32" Weight: 0.83 oz.

CDE **CORNELL-DUBILIER ELECTRIC CORPORATION**
AFFILIATED WITH FEDERAL PACIFIC ELECTRIC COMPANY



The Breakthrough ...How It Was Accomplished!

This VHF transistor breakthrough was made possible by a new Post Alloy Diffusion Process, a manufacturing method that combines the best features of the currently used alloy and diffusion processes, without their drawbacks.

The limitation of the alloy process is encountered when attempting to manufacture transistors with an average cut-off above 20 Mc. In this process the collector and emitter elements are fused (or alloyed) to the base. For this to be successfully accomplished the base must be relatively thick and the thickness very accurately controlled in order that during the fusion process the collector and emitter elements do not flow through the base and short the transistor. This relatively thick base increases the transit time, precluding any usable response above 20 Mc.

In the diffusion process the base is formed on the collector by gaseous diffusion in a high temperature oven. Very thin bases can be manufactured by this method with low transit time and very high cut-off frequencies. In this process the problem lies in attaching the emitter junction and base lead.

In the AMPEREX Post Alloy Diffusion Process, alloying and diffusion take place simultaneously. The transistor is built up on a piece of P-type germanium. Two small pellets are placed on the germanium. Pellet B, the base pellet, contains only an N-type impurity. Pellet E, the emitter pellet, contains a P-type and an N-type impurity.

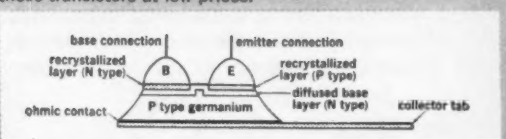
When this assembly is heated at a certain temperature, the germanium dissolves into the metal pellets until saturation is reached, and the pellet impurities diffuse into the solid germanium.

However, the P-type impurity in pellet E has such a low diffusion constant, that for practical purposes it does not penetrate into the germanium. The N-type impurity in pellets E and B has a much greater diffusion constant and readily penetrates into the solid germanium to form a diffused N-type layer underneath the pellets.

When the assembly is cooled down, a layer of germanium recrystallizes from the pellets as in the normal alloy technique. The recrystallized layer of pellet E contains many atoms of the P-type impurity and is, therefore, a P-type germanium layer. The germanium layer recrystallized from pellet B is, of course, the N-type because there are no other impurities in the pellet.

Connections are made to the germanium and the metal pellets and a "mesa-like" P-N-P transistor is obtained. The original P-type germanium is the collector, pellet B the base, and pellet E the emitter.

This process makes it possible to mass produce transistors with a base layer of a few ten-thousandths of an inch for very short transit time and high cut-off frequencies. The yield is also very high which enables AMPEREX to supply these transistors at low prices.



MAXIMUM RATINGS	2N1515	2N1516	2N1517
$-V_{CB}$	20 V	20 V	20 V
$-I_C$	10 mA	10 mA	10 mA
P_C at $T_{amb} \leq 25°C$	83 mW	83 mW	83 mW
TYPICAL CHARACTERISTICS			
Gain-Bandwidth Product (f_t, $I_E = 1$ mA)	70 Mc	70 Mc	70 Mc
Gain-Bandwidth Product (f_t, $I_E = 4$ mA)	–	180 Mc	180 Mc
Power Gain			
G at 0.45 Mc ($I_E = 1$ mA)	35 db	35 db	–
G at 10.7 Mc ($I_E = 1$ mA)	22 db	24 db	–
G at 100 Mc ($I_E = 1$ mA)	–	–	12 db
Conversion Gain G_C at 26 Mc	–	18 db	–
Noise Figure NF at 0.45 Mc	3 db	3 db	–
NF at 10.7 Mc	5 db	4 db	–
NF at 100 Mc	–	–	9 db

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At last, you can realistically use high frequency transistors for RF and IF amplifiers in production FM receivers; as mixers, oscillators and RF and IF amplifiers in mobile radio equipment, car radios and short wave receivers; and as broadband amplifiers in instrumentation and industrial applications.

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The new Amperex "Post-Alloy-Diffusion" P-N-P Transistors combine the best qualities of both the alloy and the diffusion approaches to transistor construction. As a result of the special "self-jigging" techniques, a maximum degree of uniformity is achieved. Thus the necessity for "selection" is completely eliminated.

The **2N1516** is designed for use as a mixer oscillator in short wave receivers, as an IF amplifier in FM receivers, and as a broadband linear amplifier for instrumentation and industrial applications. The **2N1516** features a high cut-off frequency of 70 Mc and a low collector-to-base capacitance of 1.8 $\mu\mu$f.

The **2N1515** is designed for high gain IF amplifier service in medium and short wave receivers.

The **2N1517** is designed for use as a local oscillator and preamplifier in FM receivers and has a power gain of 12 db at 100 Mc.

This is, of course, only the beginning of the Amperex **PADT** *story. Availability is further assured by a new Amperex* **PADT** *plant in Slatersville, Rhode Island. A range of new* **PADT** *transistors, now in the final stages of development will provide UHF performance at VHF prices and give every promise of providing increased reliability and uniformity.*

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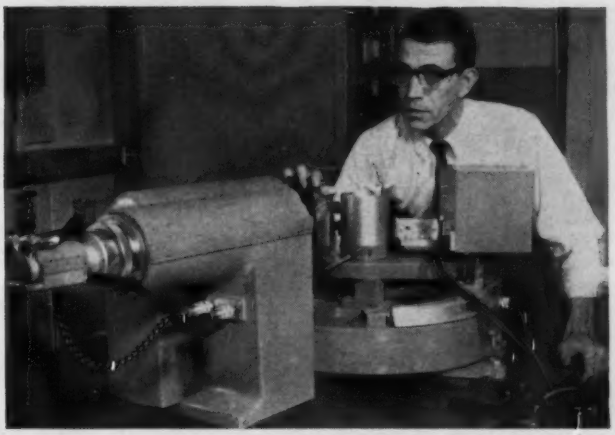
HE X-RAYS WOOD...

to help make telephone poles last longer



Chemist Jack Wright developed the use of this X-ray fluorescence machine for testing the concentration of preservatives in wood. Here he bombards a boring from a test telephone pole with X-rays.

This Bell Labs chemist is using a fast, new technique for measuring the concentration of fungus-killing preservative in telephone poles.

A boring from a test pole is bombarded with X-rays. The preservative—pentachlorophenol—converts some of the incoming X-rays to new ones of different and characteristic wave length. These new rays are isolated and sent into a radiation counter which registers their intensity. The intensity in turn reveals the concentration of preservative.

Bell Laboratories chemists must test thousands of wood specimens annually in their research to make telephone poles last longer. Seeking a faster test, they explored the possibility of X-ray fluorescence—a technique developed originally for metallurgy. For the first time, this technique was applied to wood. Result: A wood specimen check in just two minutes—at least 15 times faster than before possible with the conventional microchemical analysis.

Bell Labs scientists must remain alert to *all* ways of improving telephone service. They must create radically new technology or improve what already exists. Here, they devised a way to speed research in one of telephony's oldest and most important arts—that of wood preservation.

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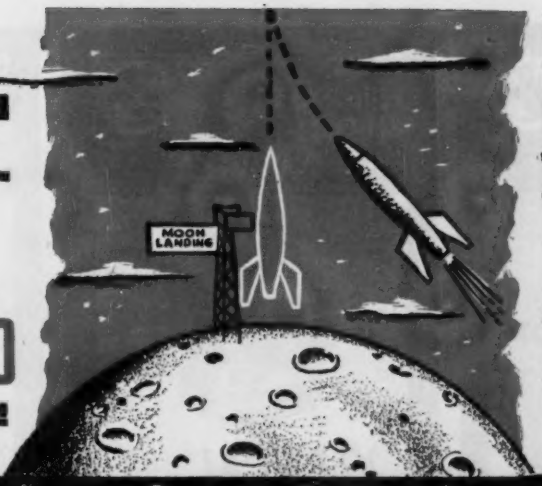

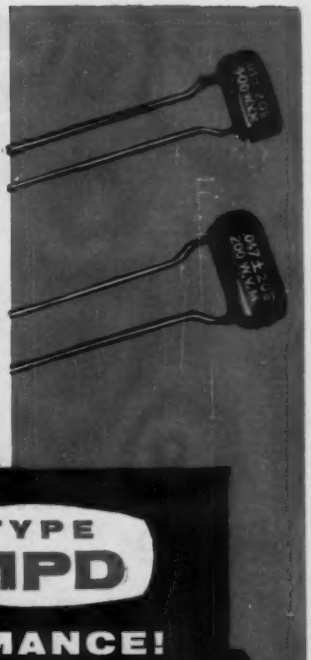

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Setting a new standard of reliability!

*Life tests have proved that El-Menco Mylar-Paper Dipped Capacitors — tested at 100°C with rated voltage applied — have yielded a failure rate of only 1 per 716,800 unit-hours for 1 MFD. Since the number of unit-hours of these capacitors is inversely proportional to the capacitance, 0.1 MFD El-Menco Mylar-Paper Dipped Capacitors will yield ONLY 1 FAILURE IN 7,168,000 UNIT-HOURS.

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1000 WVDC —	.001 to .1 MMF
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● TOLERANCES: ±10% and ±20%. Closer tolerances available on request.

● INSULATION: Durez phenolic resin impregnated.

● LEADS: No. 20 B & S (.032") annealed copper-weld crimped leads for printed circuit application.

● DIELECTRIC STRENGTH: 2 or 2½ times rated voltage, depending upon working voltage.

● INSULATION RESISTANCE AT 25°C: For .05MFD or less, 100,000 megohms minimum. Greater than .05 MFD, 5000 megohm-microfarads.

● INSULATION RESISTANCE AT 100°C: For .05MFD or less, 1400 megohms minimum. Greater than .05MFD, 70 megohm-microfarads.

● POWER FACTOR AT 25°C: 1.0% maximum at 1 KC.

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DIRECTIONAL GYRO

This compact new gyro, designed for application in high-performance aircraft and missiles, provides extremely accurate attitude data. Its liquid bubble-type vertical sensing element generates error signals proportional to spin axis displacement from horizontal, while minor wiring modifications permit sensor connection to leveling torquer, completing inner axis leveling loop.

TYPICAL CHARACTERISTICS #A2215

Environmental Capabilities
- Vibration: 5g, 20-1000 cps; 10g, 1000-2000 cps
- Temperature Range (operative): —54°C to +71°C
- (non-operative): —65°C to +85°C
- Altitude: Unlimited

Azimuth Pickoff
- Excitation: 26V, 400 cps, single phase
- Output (sinusoidal): 11.8V ± 5% max.
- Error from E.Z.: 10 min. max.

Motor
- Excitation: 115V, 400 cps, three phase
- Speed: 23,500 RPM
- Power: Starting: 35 watts; Running: 7.5 watts

Performance Characteristics
- Drift: 4°/hr. max.
- Leveling Rate: Between 2° and 4°/min.
- Azimuth Torquing Rate: 360°/min. (intermittent) 40°/min. (continuous)

Write for complete data.

BASIC BUILDING BLOCKS FROM KEARFOTT

VERTICAL GYRO

Kearfott's rugged new vertical gyro, designed for missile application, is a two-degree-of-freedom instrument with 360° of freedom about inner gimbal axis. Self-contained vertical erection system incorporates liquid bubble-type vertical sensing device.

TYPICAL CHARACTERISTICS #B2115

Environmental Capabilities
- Vibration: 5 g, 20-1000 cps; 10 g, 1000-2000 cps
- Temperature Range (operative): —54°C to +71°C
- (non-operative): —65°C to +85°C
- Altitude: Unlimited

Pickoffs
- Excitation: 26V, 400 cps, single phase
- Error from E.Z.: 10 min. max.
- Output Voltage (line to line): 11.8V ± 5% max.

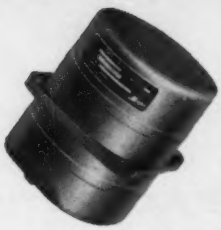
Motor
- Excitation: 115V, 400 cps, three phase
- Power: Starting: 35 watts; Running: 7.5 watts

Performance Characteristics
- Repeatability of Established Vertical: To within a cone of half angle equal to 12 minutes of arc
- Scorsby Drift Rate in 5 Min. Time: 0.3°/min. (average)
- Erection Rate: Normal: Between 2° and 4°/min. Fast: 80°/min. intermittent, 40°/min. continuous

Physical Features
- Anisoelastic Drift: 0.08°/min/g² at resonance
- Weight: 5.5 lbs. (approx.)
- Mass Unbalance: 0.1°/min/g

Write for complete data.

BASIC BUILDING BLOCKS FROM KEARFOTT



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A highly reliable, two-degree-of-freedom instrument utilizing AC synchro transmitters at each gimbal axis. Designed to operate under the most severe missile conditions, this gyro has AC torquers mounted at each gimbal axis to permit command positioning or slaving of spin axis to desired reference position; each torquer capable of producing a precession rate of 360°/minute with 12.5 watts/phase power input.

TYPICAL CHARACTERISTICS #Q2315

Environmental Capabilities
- Temperature Range: (operative): —54°C to +71°C (non-operative): —65°C to +85°C
- Altitude: Unlimited
- Vibration: 10g, 10-2000cps

Pickoffs
- Excitation: 26V, 400 cps, single phase
- Output (sinusoidal): 11.8V ± 5% max.
- Error from E.Z.: 10 min. max.

Motor
- Excitation: 115V, 400 cps, three phase
- Speed: 23,500 RPM
- Momentum: 2.25 x 10^6 gm cm^2/sec.

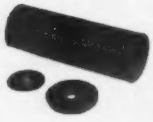
Caging and Preset Provision (Electrically energized torquer type)
- Excitation: 115V max./phase
- Torquer Constant: 22.8 dyne cm/$Volt^2$

Performance Characteristics
- Free Drift: 5°/minute each axis
- Runup Time: 1 minute max.
- Torquing Rate: 360°/min. (intermittent) 40°/min. (continuous)

Write for complete data.

Synchronous Motor

Ferrites



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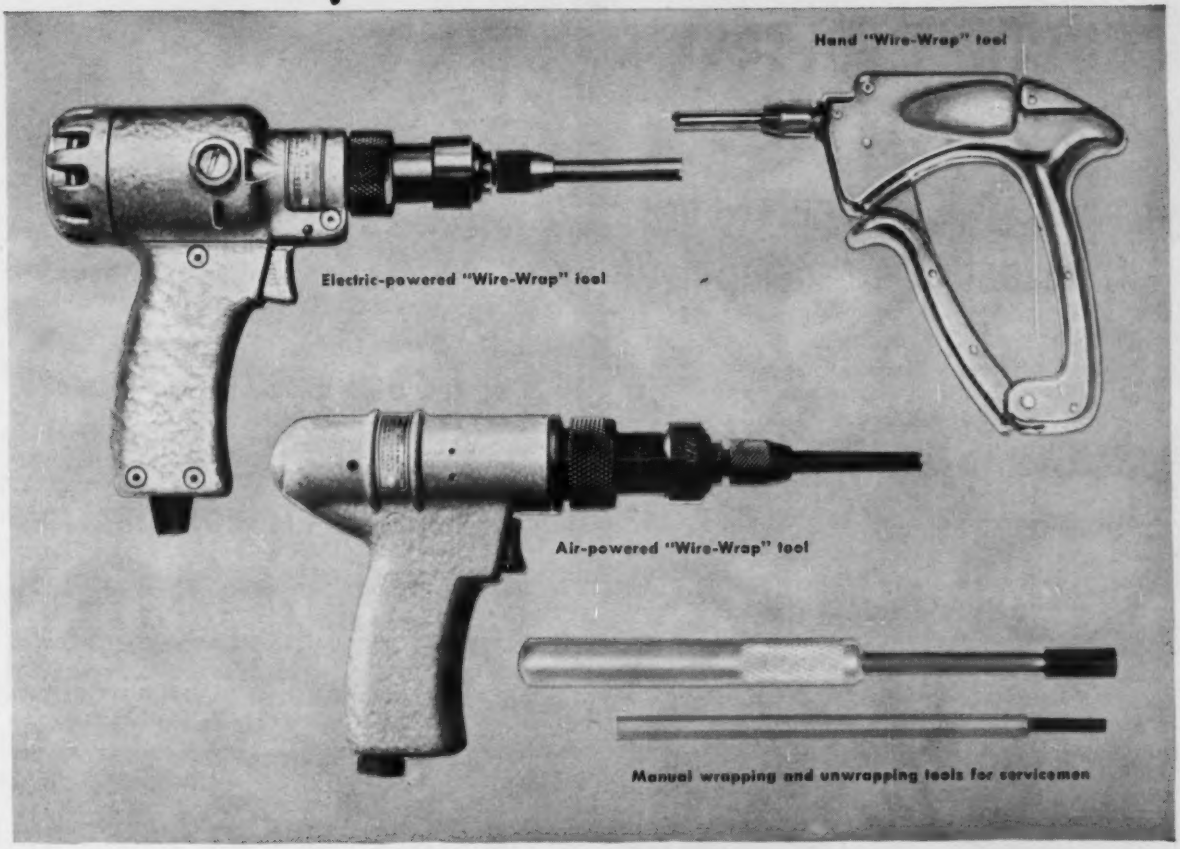
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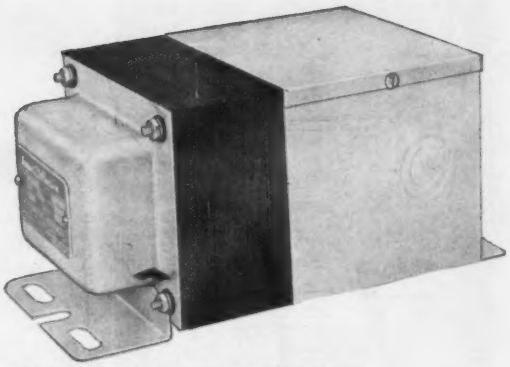

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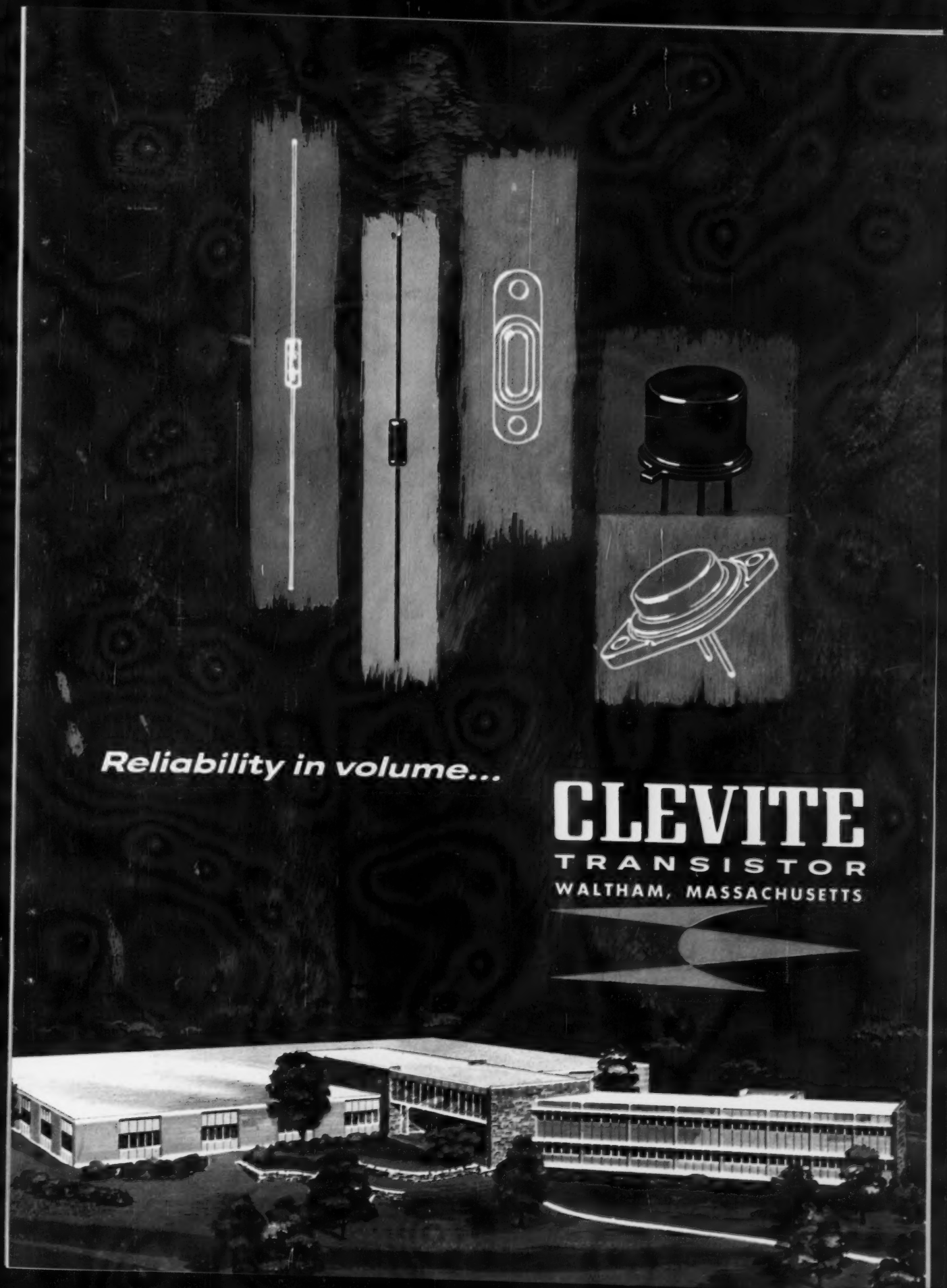
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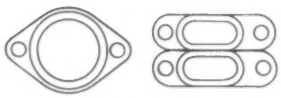

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THREE AMPERE SWITCHING TYPES

TEST	UNITS	CTP 1728	CTP 1735	CTP 1729	CTP 1730	CTP 1731	CTP 1736	CTP 1732	CTP 1733
Min BVcbo @ 2 ma	volts	40	60	80	100	40	60	80	100
Min BVceo @ 500 ma	volts	25	40	55	65	25	40	55	65
Min BVces @ 300 ma	volts	35	50	65	75	35	50	65	75
Max Icbo @ 85°C @ Max Vcb	ma	7	7	7	7	7	7	7	7
Typ. Icbo @ 2 V	μa	20	20	30	30	20	20	30	30
D. C. Current Gain @ 0.5A		30-75	30-75	30-75	30-75	60-150	60-150	60-150	60-150
Max Veb @ 3.0 A	volts	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Max Vce(sat) @ 3.0A, 300 ma	volts	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Min fae @ 1.0 A	kc	15	15	8	8	10	10	6	6
Max Thermal Resistance	°c/w	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5

Compared with present power transistors of similar ratings, the new Clevite ***Spacesaver*** gives you important new advantages.

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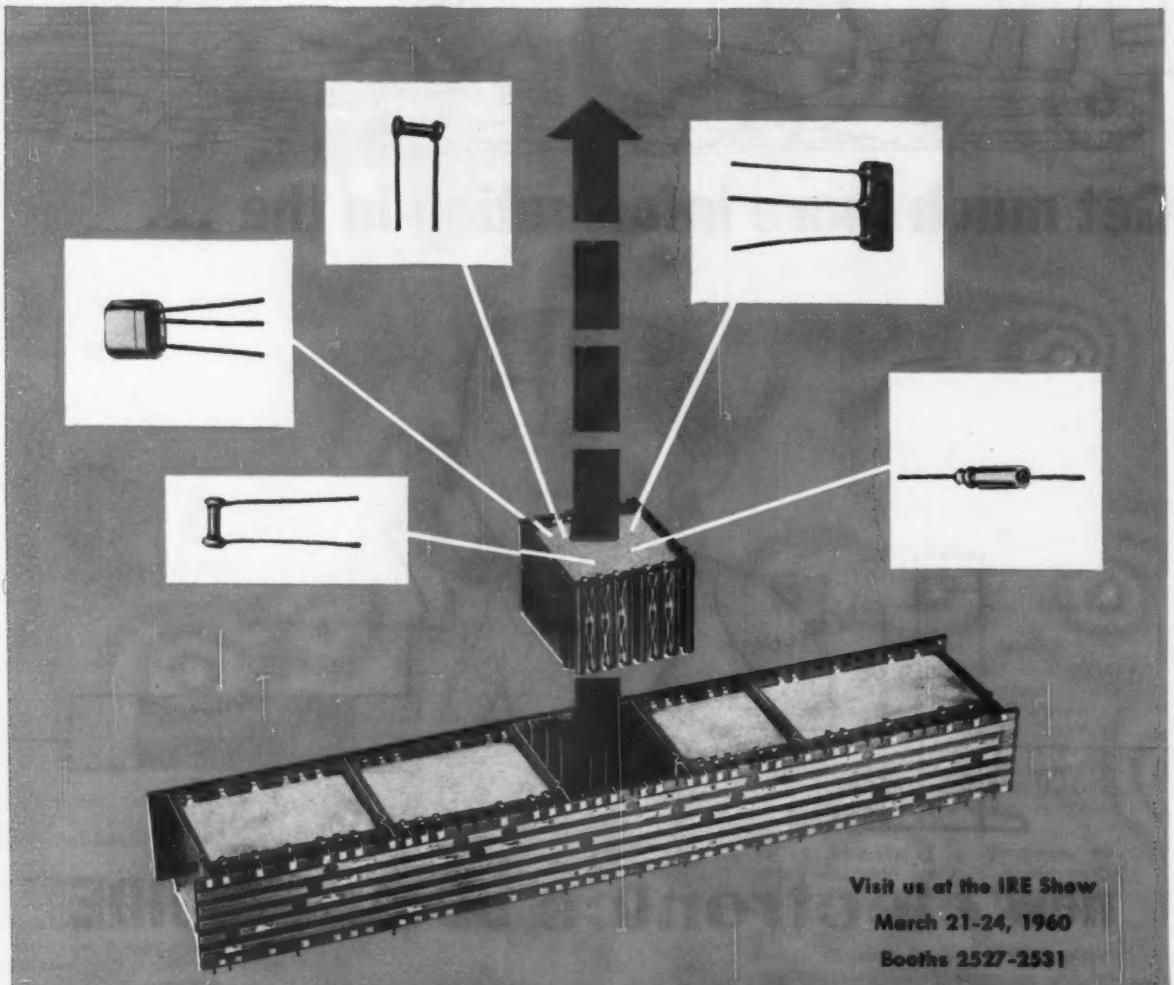

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International IRE

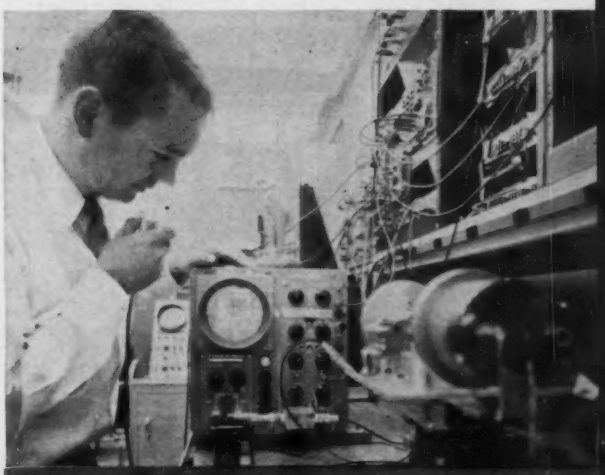
electronics

MARCH 11, 1960

Future Developments In Engineering

As engineers gather in New York for the 1960 International IRE Convention, major interest centers on developments now emerging from the laboratory. Here's a look at what lies ahead

By **THOMAS EMMA**, Associate Editor,
MICHAEL F. WOLFF, Assistant Editor



Oscilloscope shows pattern for the spoken words "San Francisco" in speech pattern generation experiments at IBM. Work is aimed at determining the unique characteristics in sound.

Bell Labs' engineer sub-cools specimen of a new ternary semiconductive with liquid nitrogen during a typical materials research experiment. Typical properties being measured are carrier mobility, resistivity and magneto-resistivity

IN EVERY BRANCH OF today's electronics industry, new developments lie ahead. The scientists, engineers and technicians who shape our future are finding new and better ways to communicate, to solve problems and to expand the horizons of knowledge.

It would be literally impossible to describe each new development that lies ahead. In surveying the immediate practical future, however, certain salient developments emerge. An idea of what lies in the far future may be had by looking at some of these.

COMPUTERS—New developments in learning systems, cryogenics, miniaturization and microwave techniques are topics most frequently mentioned in the immediate future of computers.

In the area of learning, such systems as the Perceptron, the Artron and others are coming under close scrutiny. The Artron (see Fig. 1), still in the theoretical stage, consists of a semi-randomly connected network of artificial neuron-like decision units and generalized goals operating on the "reward and punishment" system. The Perceptron for which hardware exists is described as a machine able to perceive, recognize and form conclusions.

As indicated in Fig. 1, the Perceptron utilizes binary devices known as response units that are activated by randomly-selected units in the association system. When activated, the response units transmit feedback signals to their associated source sets that tend to multiply the activity rate, resulting in a form of reinforcement.

Work done on self-organizing learning machines has resulted in systems which can play checkers and chess, solve plane geometry problems and solve equa-

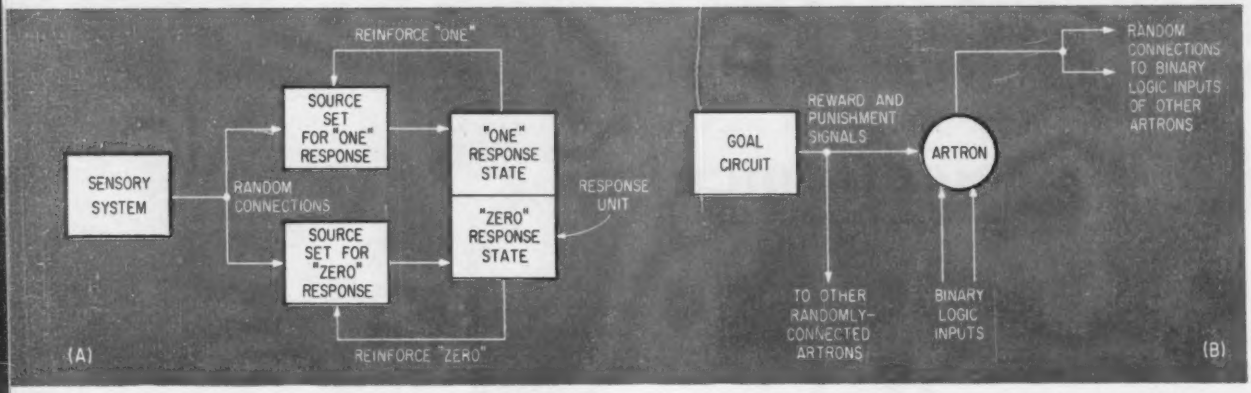


FIG. 1—Block diagrams for Cornell Aeronautical Labs' Perceptron (A) and Melpar's Artron (B) illustrate two approaches to the development of learning machines

tions in symbolic logic. The main advance represented by these systems, in the opinion of most computer men, is that the way has been pointed to means of raising the level of sophistication of computer technology. Final applications, though discussed with caution, will eventually lead to a host of functions ranging from operation of factory production lines to battlefield surveillance and tactics.

TUNNEL TRIODES—One line of tunnel diode computer research involves the tunnel triode—a transistor-like structure in which the emitter-base junction is a tunnel diode and the collector-base junction a conventional diode. In a computer application, the triode could be biased so the emitter-base circuit, which exhibits the conventional tunnel diode negative conductance, has two stable states: a low resistance state in the tunnel-current phase and a higher resistance state in the normal diode forward current phase. The former is associated with high collector resistance and the latter with low collector resistance. Thus, the input and output can be separated and the state of the emitter-base tunnel diode determined in the collector circuit.

One area slated for intense consideration will be the possible application of analog computers to functions now performed by digital equipment. There are some computer men who feel that users have been made more aware of digital computers than they have of analog gear. The result, in some cases, has been inefficient use of equipment. An expected result in the near future will be a combining of analog and digital techniques to a greater extent than is now being done.

COMMUNICATIONS—Keynote of communications in the next few years will be growth. More traffic handling capability and more methods of communication will be the goal of researchers.

One phase of this will be an experiment slated for this spring. Researchers will send aloft a 100-ft. aluminized balloon which will act as a passive reflector in a one-hop system. The next step in the development of orbiting satellites as a means of communication will be experiments with an active system placed aloft. Researchers consider masers as greatly important to the future of such systems. Present estimates are that masers can operate at about 100 times less power than equivalent vacuum tube equipment.

Microwave systems, both line-of-sight and over-the-horizon will come in for increased attention during the next two years. One development slated for growth is Bell's TH microwave system, able to double the present capacity of common carrier line-of-sight links by the use of newly-designed antennas and ancillary equipment.

Over-the-horizon systems are now going up which will give more channels for military communications in the arctic. In addition, there are expectations that the next few years may see the beginnings of troposcatter systems in Latin America and possibly in certain sections of the Orient.

Single-sideband and double-sideband equipment is expected to see a considerable amount of increase in the near future. A spokesman of one major communications corporation says the "surface is just scratched" in this area. Development of new equipment permitting operation at higher power levels is cited as one important factor that will spur growth in SSB traffic.

In addition to squeezing more work out of existing spectrum space, one hope for the immediate future will be the stretching of the spectrum by utilization of the millimeter-wave region. Researchers have been probing the area above 35,000 Mc for about seven years and have already developed a significant amount of actual hardware. Problems now being attacked in connection with millimeter-wave studies center about development of increased power output. More than one research group feels that the bulk of the power problems are just about solved. Parametric amplifiers are said to show considerable promise in allowing the desired powers to be attained. Mixing and detection systems as well as generators, antennas and receivers now exist which can be used in millimeter-wave transmission.

A most important area of application now seen

for millimeter-wave gear is communication with space vehicles during reentry.

BROADCASTING—Engineering developments in commercial broadcasting in the immediate practical future will center around increased station automation. Continued attention will probably center around devices and systems to perform switching functions for program input and output sources. It is likely that a greater amount of instrumentation will find its way into television stations rather than radio stations because of the greater complexities of transmitting video and audio at the same time.

Adding to the need for equipment to perform switching functions rapidly is the continuous rise in the amount of magnetic tape recording that is being used in television. Network stations that handle this taped program fare will require increasing amounts of automatic equipment for inserting local programming in the form of slides, film and live fare into the taped output.

Stereophonic broadcasting, the subject of much recent speculation, will not be making the big breakthrough for some time according to a number of broadcasters interviewed. In terms of engineering, much of the hardware for both transmission and reception is already in existence. The stumbling block, as many see it, will continue to be the absence of hard-core specifications.

Although much experimental work has been done in the use of single sideband in radio broadcasting, it appears unlikely that much will be done in the way of engineering of new equipment for the next 24 months. Pressures both economic and technical to push for development of commercial SSB gear are not strong enough at this time.

From discussion with a number of broadcasters both in radio and television, it appears unlikely that any profound changes will be made in commercial broadcasting as a result of the Geneva Conference on frequency allocations. (ELECTRONICS, Feb. 19, 1960, p 33).

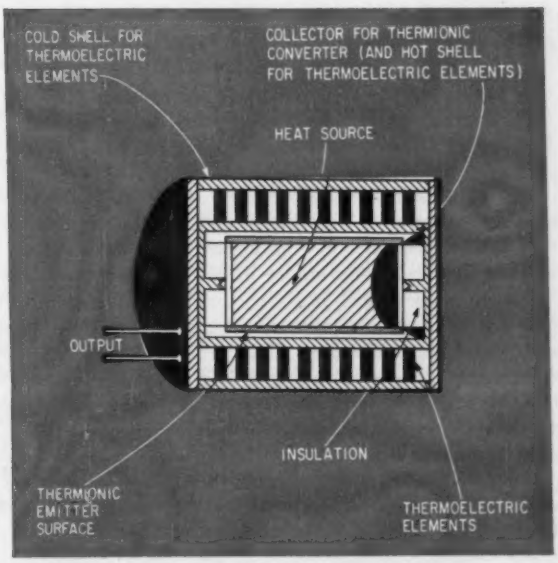
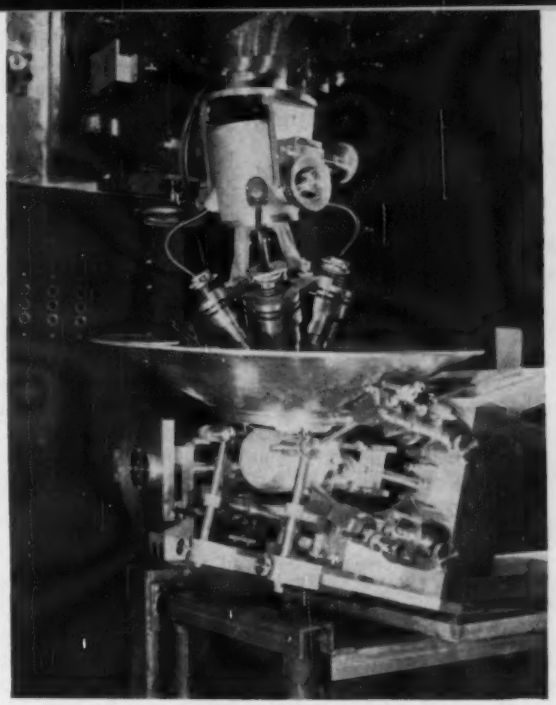


FIG. 2—One design approach to cascaded thermoelectric and thermionic converters being considered at General Instrument is illustrated. Heat source could be nuclear or focused solar energy



Four-beam focusing irradiator is used for ultrasonic neurosurgery studies at Massachusetts General Hospital. Human skull is shown mounted in head holder

MICROMINIATURIZATION—Extensive work in the several approaches to microminiaturization will mark the effort in this field during the two years ahead. Microminiature diodes and other minute components will appear in appreciable numbers during this period in engineering prototype equipment. Also, there will be greater use of high-density packaging techniques for standard components using welded interconnections and resins.

Within the next twelve to twenty-four months, *en-bloc* (solid) circuits are expected to show up in such items as digital computers still in the laboratory stage. There, *en-bloc* circuits will be used as flip-flops, AND gates and OR gates. Digital computer 10-Mc logic elements in small transistor cases will most probably be available within a year. Fabrication of these devices will rely on diffusion and deposition techniques.

Researchers at Westinghouse hope to show that their molecular electronics concept for *en-bloc* circuits is feasible for systems applications with the production of a uhf receiver by 1962. Other firms are also active. Major areas that will claim attention during the next few years will be reliability, heat dispersion and integration with tunnel diodes.

One promising approach to microminiaturization is the thin-film technique in which discrete components are deposited on a single wafer and interconnected by evaporated materials. Major research effort in thin-films will be to deposit active elements and improve material handling techniques to allow

greater resolution and lower costs. Some researchers have already reported resolutions of a few hundred angstroms using electron microscope-type techniques.

DIRECT CONVERSION—The next two years will see increased progress in the development of devices for converting heat into electric power without the use of moving parts.

For thermoelectric converters, observers anticipate the emergence of special purpose power generators with operating efficiencies of 15 percent. Special devices foreseen include a 100-Kw water-cooled generator with 10-percent efficiency for laboratory demonstration. Also expected are generators ranging from 200 to 500 watts with operating efficiencies of about 6 percent. These will be used in satellite applications.

Achievement of 15-percent efficiencies is predicted on the basis of expected progress in material research. Especially promising are ternary compound semiconductors and transition metal compounds, as well as the solid solution alloys of these substances.

Major efforts of materials-study groups will be attempts to raise operating temperatures and figures of merit. A breakthrough in high-temperature thermoelectrics is not expected within the next two years. Anticipated, however, is a demand for thermionic converters at high temperatures in general, and ranges above 1,500 C in particular.

Demand will most likely bring about significant improvements in thermionic converters during the next two years. Vacuum diode converters with 10 to 15-percent overall efficiencies are expected to be in limited production within the next 24 months. These will have module power ratings of 200 to 500 watts and will be capable of being arranged in series for total outputs as high as 10 Kw.

These improvements will result from extensive materials research aimed at finding collector materials having the lowest possible work function consistent with the emitter chosen and the device lifetime.

One very likely application of vacuum diode converters within the near future will be for space vehicles in which solar energy will provide emitter heat source.

CESIUM DIODES—Prototype 100-watt cesium diodes with efficiencies of 15 to 20 percent are expected to be available for such specialized applications as auxiliary power sources for space applications two years from now. Major research effort for this class of device is directed towards the problem of understanding the functions of the plasma in various parts of the converter, and improving production techniques and materials technology. Research is also aimed at finding structural materials that can withstand the corrosive effects of cesium at temperatures as high as 2,300 C. One group of materials being studied in this connection includes such ceramics as zirconium carbide.

One approach to increasing efficiency of direct conversion systems is the cascading of thermoelectric and thermionic converters. One such possible combination is shown in Fig. 2. Such a system would use the reject heat from one converter as the source heat for the next.

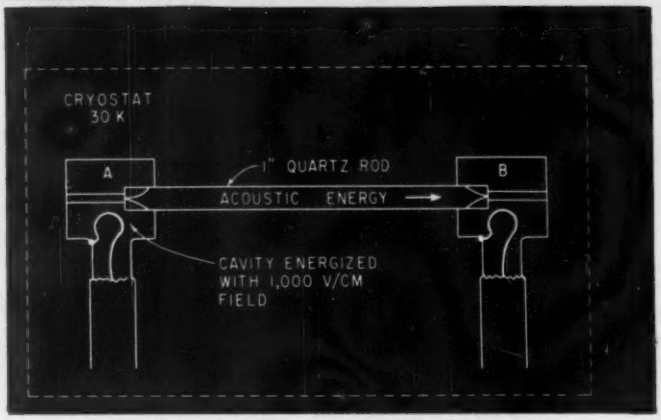


FIG. 3—Acoustic energy at frequencies above 10,000 Mc might be used in a quartz delay line of this type for information storage. Acoustic energy is reconverted to electromagnetic energy in cavity B

Magnetohydrodynamic (MHD) power generation appears to be several years distant as a commercial power source. Stationary MHD power generators are large power devices becoming efficient above ten megawatts. Present research in this area centers on cost reduction and increased efficiency.

THERMOELECTRIC COOLING—Materials having figures of merit between 4 and 5 are expected to be available within two years. According to industry sources, this means that thermoelectric refrigeration will come near to being as efficient as compressor-type refrigerators. However, the most likely applications of thermoelectric cooling within this period are of the special type, such as cooling infrared detectors, spot-cooling of electronic equipment and military applications.

LOW-NOISE DEVICES—With noise figures already to the point where antennas are becoming the limiting elements, low-noise device work during the next two years will turn increasingly to pushing toward higher frequencies, designing gain-stable systems for untrained operators and developing new forms of quantum-mechanical amplifiers.

For masers, the search for new materials, such as emerald, will play a key role in obtaining millimeter-wavelength operation. Another approach being worked on is to generate or amplify very high frequencies on a pulsed basis by converting magnetic field energy, supplied to an inverted spin distribution, into coherent radiation. This technique has been demonstrated by starting with low-frequency operation of a pulsed field maser and extending to the millimeter region by systematically increasing the peak pulsed field.

Continued and important growth is foreseen in the next two years for the optical and infrared masers. These devices are expected to become significant for space communications because they give coherent sources of energy with narrow bandwidths. Working infrared and optical masers for communications and radar-like purposes are expected within two years.

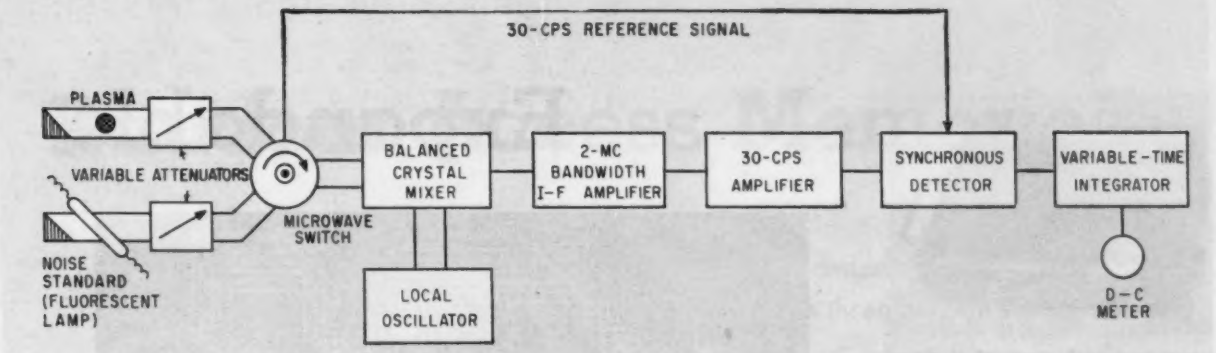


FIG. 4—MIT's S-band radiometer measures noise radiated from plasma at power levels down to 5 x 10^{-17} watts. Plasma is contained in tube which passes through waveguide in direction perpendicular to direction of propagation and oriented either along or transverse to electric field in the dominant TE_{10} mode

A wide variety of solids, liquids and gases are being investigated as offering reasonable possibilities for the device material.

Low-noise parametric amplifiers with variable-capacitance diodes will also receive considerable attention and are expected to start appearing in operating systems. The trend will be to use more diodes per amplifier to achieve isolation, pump suppression and self-protection. Along with achieving more sophisticated circuit design, a major effort will be expended in diode materials technology. While some workers predict diffused silicon diodes being widely used in receivers for all frequencies through 16,000 Mc, a lot of work is being devoted to gallium arsenide because of its higher carrier mobility. Proponents of this material expect to have the problems associated with doping and high-temperature processing of gallium arsenide under control within two years.

ESAKI DIODES—Although it is possible that tv sets using Esaki tunnel diodes will be in the preliminary circuit design stage two years from now, the major applications for tunnel diodes are more likely to be in industrial and military electronics in this period. Areas most often mentioned as being realizable are communications systems above 3,000 Mc, reactor control circuits and computers. It is in the computer area that tunnel diodes are expected to find the most use during the next two years, with some workers predicting laboratory-model tunnel diode computers with 50-Mc information rates.

Packaging and exploitation of new materials will receive major attention. Gallium arsenide looks promising because of its power handling capability (four times that of germanium diodes in the gigacycle range) and its peak-to-valley current ratio (60 to 1); indium antimonide tunnel diodes have been predicted as possibly leading to millimeter-wavelength amplification.

ULTRASONICS—Having proved its value in such applications as cleaning and fatigue testing, the field of ultrasonics is expected to grow even greater.

Further refinement in cleaning and testing techniques as well as welding in specialized application is seen to be a certain development. In addition, increasing attention will be paid to development of new devices and in study of hypersonics, (behavior of sound above 1,000 Mc.).

In hypersonics, one phenomenon that will receive much attention centers around evidence that sound at 30 K can be transmitted with practically no attenuation. One possibility suggested by this is the use of high-frequency delay lines to store large amounts of information in a limited amount of space. Researchers say this may point the way to computer storage applications. One possibility is a quartz rod delay line as shown in Fig. 3. In such a device 10,000 bits of information can be stored at 10,000 Mc.

Present research programs are aiming for 35,000 Mc with hopes of eventually reaching 100,000 Mc.

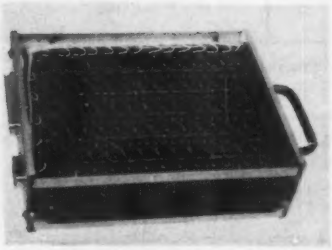
PLASMA PHYSICS—Research into the properties of plasma will play an increasingly important role in such areas as controlled thermonuclear fusion, ionospheric communication, thermionic converters and telecommunications during space vehicle reentry. In addition, however, considerable work is underway in the use of plasmas to develop new microwave circuitry and generate extremely high power at very short wavelengths. Judging from current research results, some researchers expect basic research in this field to bear fruit in two years.

Among techniques developed for plasma research is microwave measurement of electron temperature, one of the fundamental parameters of interest. An S-band radiometer that calculates electron temperature by measuring the noise radiated by the plasma is shown in Fig. 4.

MEDICAL ELECTRONICS—Although a considerable number of devices have been provided which permit medical tasks to be performed electronically, doctors see the next few years as being marked for increased growth in understanding. Based on past accomplishments by both medical men and engineers, it appears that there is more awareness on the part of each of the way they can be of mutual aid in research and development programs.

Regarding present equipment, a vital need seen for the near future is research that will bring down costs and make today's devices available to a greater number of users.

Expandable



Memory package is composed of spaced stack of five core planes, a top and bottom shield plane, and a top and bottom diode board

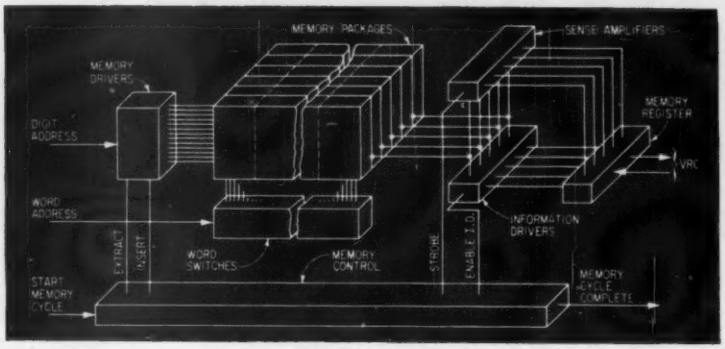


FIG. 1—In this expandable memory, a variable number of memory packages may be used

PLUG-IN MEMORY packages form the basis of an expandable solid-state linear select memory used in the Burroughs B-251 Visible Record Computer (VRC). This computer, which operates over a wide range of temperature and supply voltages, is a small digital computer designed for banking and similar business applications.

Input is provided by a sorter-reader which is capable of high-speed sorting and reading of checks and other items using the magnetic-ink character recognition system of the American Bankers Association. Output is provided by an integrated, automatic ledger and journal posting handler.

Memory for the VRC uses magnetic cores operated in an expandable linear select random access array. This memory, which is variable in size, is designed to permit a wide latitude in component tolerances.

Memory Description

Block diagram of the expandable memory is shown in Fig. 1. Each memory package has 10 groups of addresses (words) shown being addressed from the word switches at the bottom of the memory block. Each word has 13 addresses (digits) which are selected by the memory drivers shown at the left of the memory packages, and each address has a capacity of five bits, one in each of the five bit planes. Word switches are associated with individual memory packages; consequently, additional word switches must be added when memory packages are added. The memory drivers are connected to all packages in parallel and the bit planes of all packages are connected in series. The memory control circuits control the operation of the memory upon receipt of the start pulse and then return a *complete* pulse to the computer at the conclusion of the extract-insert cycle.

With the linear select memory configuration, as will be explained, the disturb currents are only one third of the full switching current; thus, the memory uses less critical currents and components, and operates over a wide temperature range. A typical memory address, as in Fig. 2, is reached by first selecting one of the bilateral word switches. It is normally energized on a d-c basis and permits the addressing of all digits in the selected word. A memory driver (extract and insert) is then selected by a digit address from the computer. The digits are generally addressed in sequence within each word. At the arrival of the start pulse, the extract timing pulse passes through the one opened digit gate and causes the extract driver to conduct the full switching current. The sense amplifiers receive the switching voltage of the cores which were storing *ONE*'s by means of the bit plane winding. A strobe pulse permits the output of the sense amplifiers to transfer the information to the memory register. The sense amplifier gate also has an erase input to prevent the old information from reaching the memory register while new information is being inserted. The information driver enabling pulse immediately turns on the information drivers, either + ⅓ or − ⅓ full

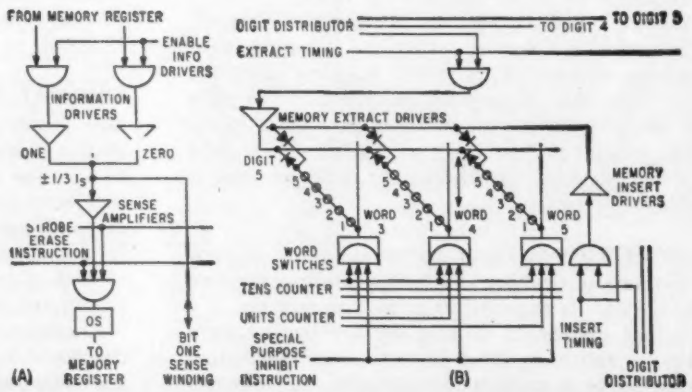


FIG. 2—Shown here in (A) and (B) are basic elements of a typical memory address

Random Access Memories

These expandable solid-state memories operate in an ambient temperature of from 15 to 55 C and require no better than plus or minus three percent supplies. Plug-in feature provides unusual economy

By **GEORGE E. LUND**, Development Engineer, **and DONALD R. FAULIS**, Associate Development Engineer, Burroughs Research Center, Paoli, Penna.

switching current depending on the state of the memory register. The insert memory driver is then caused to conduct a $-\frac{2}{3}$ switching current which, in combination with the mmf produced by the information drivers, produces either a full switching mmf or an inconsequential $\frac{1}{3}$ switching mmf. A *complete* pulse is then returned to the parent system.

Since speed is not a problem, the minimum memory recycle time is made approximately 80 μs which has the advantage of low dissipation and reduced recovery time problems. The memory access time is approximately 10 μs.

Memory Package

The memory package is composed of a spaced stack of five core planes, a top and bottom shield plane, and a top and bottom diode board. The cores are loosely laminated between sheets of paper base phenolic laminate on which a part of the series-connected bit plane winding is printed. The discontinuous printed pieces of the bit winding are connected by means of staples which pass from one printed pad through a core to the back of the board and then through a second core to the next printed pad. Short leads are used from the corner of the core planes to the small connector, which is adjacent. Transverse wires are inserted through each stack of five cores and soldered to the diode boards at either end. Digit address wires within each word are connected longitudinally by the printed circuit on one diode board while the diodes for that word group are mounted on the opposite diode board. The pattern is alternated so that the same diode board can be used for either side. Digit extract and insert lines are printed on the under-side of the diode boards and run from side to side. Word and digit leads terminate on the large connector and are dressed along the bottom and edges of the package opposite to the side on which the bit plane windings are connected.

Addressing Circuits

A memory address is chosen by the computer, which selects a word by means of the word switches and then selects a digit through the digit's memory current driver.

The word switch, Fig. 3, which closes the selected word circuit, is basically a bilateral switch. A symmetrical transistor, RCA TA1703C, is used; two additional transistors are required in the circuit, a 2N269 buffer driver and a 2N269 input decoding gate. A *units* and *tens* input

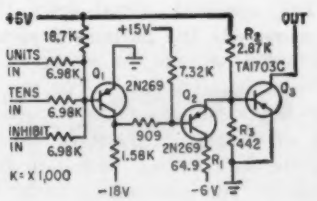


FIG. 3—Word switch, which closes the selected word circuit, is basically a bilateral switch

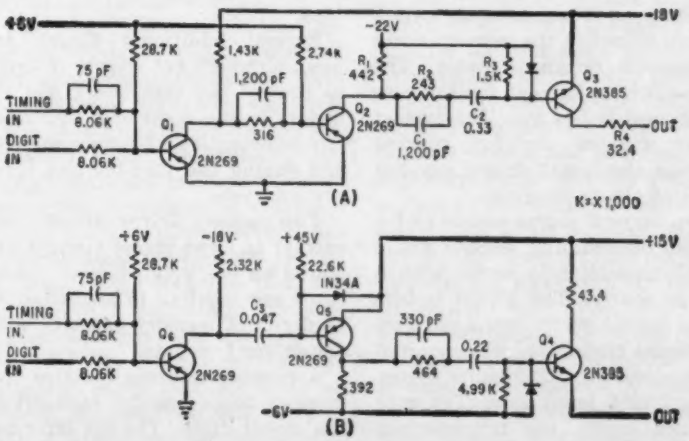


FIG. 4—Memory driver consists of an extract driver circuit (A), which supplies current to extract information from the memory, and an insert driver circuit (B), which supplies current to insert information into the memory

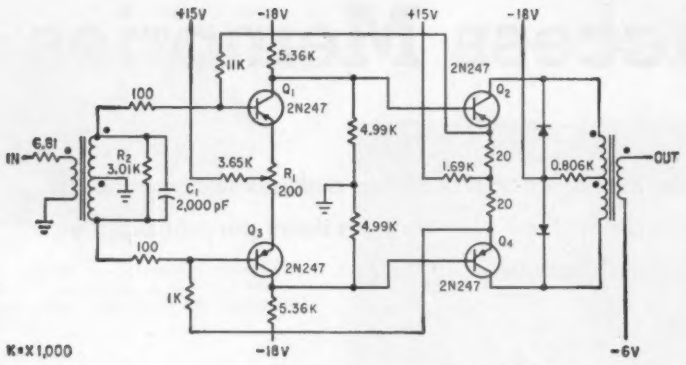


FIG. 5—Minimum input from the cores to this sense amplifier is 30 mv

is used to select a particular word. The third input to the gate is for a special purpose inhibit instruction. A word switch must be selected at least 10 μs before the memory start pulse is received. This presaturates Q_3 in preparation for the memory driver currents. The transistor requires a heat sink to keep its junction temperature below 75 C with a 55 C ambient at maximum dissipation. Collector-to-emitter voltage is less than $\pm$0.3v when passing the full 500-ma memory current. Divider resistors R_2 and R_3 are used to insure that the TA1703C is biased OFF in the unselected circuits; R_1 assures bottoming of Q_3 when the circuit is selected. Worst case design approach is used throughout.

Four of these circuits are placed on one 4½ by 7-inch printed circuit card. Twenty-five cards are required to accommodate the full 100-word memory.

The memory driver (Fig. 4) consists of two circuits, one to supply current to extract information from the memory and the other to supply current to insert information into the memory. These currents switch or help to switch the memory cores to opposite remanent states. The full switching current for the core being used is 500 ma. The extract driver supplies the full current whereas the insert driver supplies but ⅔ of the full current.

The current source consists of a current determining resistor and a 2N385 transistor in series with a voltage source. The 2N385 is bottomed during driver operation. Two additional transistors are required in the circuit, a 2N269 buffer driver and a 2N269 input gate. The gate has two inputs, one for selection of the memory driver (digit) and one for timing the driver in the memory cycle. Extract and insert circuits are very similar, the difference being the direction of current flow and the resulting bias and voltages required.

In Fig. 4, R_2 is the base current determining resistor; R_1 and R_3 are used to supply reverse base current to quickly turn off Q_3. Capacitor C_2 is used in the circuit as an a-c coupling to insure that Q_3 cannot be inadvertently held on continuously, thereby preventing over-dissipation of Q_3 and R_4. C_2 discharges through R_1, R_2, and R_3. Capacitor C_1 is a speed-up capacitor shunting R_2, which reduces Q_3 base delay and rise time. One small difference in the insert circuit is the a-c coupling C_2 which is used instead of a simple resistance circuit to couple the first and second stages. This was used to accommodate the power supplies available and a standard input gate which accepts a −7v to ground signal from the computer. The IN34A in Fig. 4B is used to hold Q_3 normally off by applying a positive d-c bias.

Several additional diodes are used, although not shown, in order to protect the transistors and resistors in the event of a failure of any combination of supply voltages and during the turn-ON and turn-OFF intervals.

Two memory driver circuits, two extract and two insert circuits are placed on one printed card. Seven cards are required to accommodate 13 digits of memory capacity with one driver for spare.

A memory address contains five memory cores, one for each bit in the stored digit. The bit information is handled in five parallel channels. Each channel contains the memory cores of all addresses for that bit, a sense amplifier to amplify the core outputs and an information driver to insert ZERO or ONE information in the addressed core.

Sense Amplifier

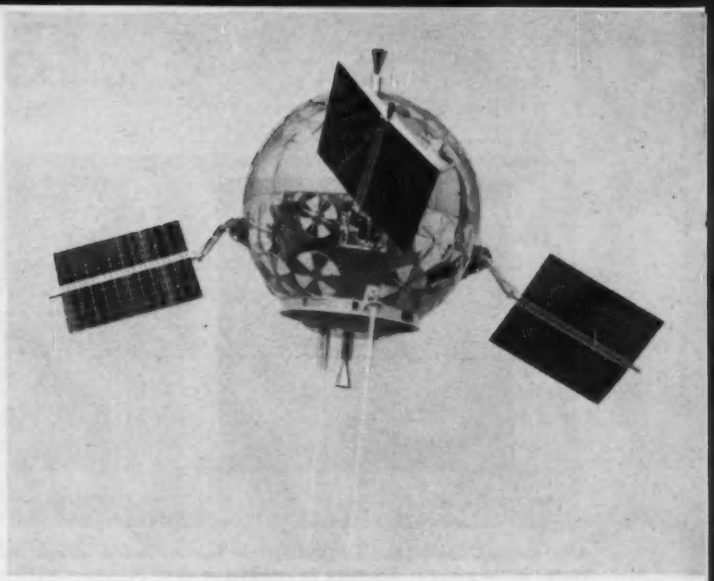
The minimum sense amplifier input from the cores is 30 mv. The minimum output pulse is 6 v. The amplifier is balanced to reduce common mode noise and reduce the pulse repetition rate sensitivity which would have resulted by the use of RC decoupling circuits. The sense amplifier uses two stages of 2N247 transistors as shown in Fig. 5. Resistor R_1 is required to achieve a balance in the amplifier with initial variations in the components.

Noise is a major problem in the design of the sense amplifier. The information driver, which is physically connected to the same channel wiring as the sense amplifier, contributes the largest portion of noise. The noise is discriminated against, in time, by a strobe gate at the output of the sense amplifier.

Noise is also produced by the capacitive coupling of the sense winding and the memory extract driver. This situation is aggravated by the long length of the sense winding necessitated by the plug-in type memory packages. An RC filter (R_2, C_1) is used at the input of the sense amplifier to help reduce this noise.

The amplifier has negative feedback in each emitter circuit and overall feedback for gain stability with a range of components and temperature variations.

The amplified signal from the memory sets the memory register for buffer storage, by means of a one-shot multivibrator. The register selects the ZERO or ONE circuit of the information driver when inserting the information back into the memory. The information driver is very similar to the memory driver, except that it drives plus or minus ⅓ of the full switching current. As explained previously, the insert memory driver supplies ⅔ of the full switching current; therefore, the information mmf is added to or subtracted from the insert mmf to insert a ZERO or ONE.



THE FRONT COVER—Once in orbit, Able space probe appears as shown with solar cell-bearing paddles extended.

Solar-Cell Power Supplies For Satellites

For reliability in the space environment, silicon solar cells are proving their worth. In this article, basic design considerations are treated with details of their applications to the Able-4 Atlas space probes

By ROY M. ACKER, ROBERT P. LIPKIS, RAYMOND S. MILLER and PAUL C. ROBISON,
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SPACE PROBE power sources that operate unattended for considerable lengths of time have been necessary for some time, and the sun has been obvious as a convenient source of power. Because of weight limitations in space vehicles, devices which convert solar radiation directly into electrical power have immediate appeal. The three space vehicles in the NASA Able-3 and -4 programs have all used a system for electrical power supply in the payload which has involved special adaptations and designs.

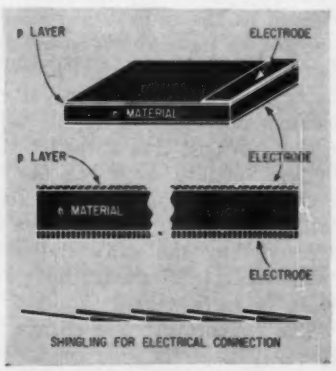


FIG. 1—Construction details of cells and method of connecting

Basically, these vehicles have relied on silicon solar cells cemented on four paddles extended out from the surface of the vehicle and operating in conjunction with storage batteries within the vehicle. Although there are minor differences among the three vehicles, the basic design for the power supply has been the same throughout. One of the goals of the design, in fact, was to achieve a sufficiently versatile system so that it could apply equally well to the three missions: the large elliptical earth satellite orbit of Able-3, the lunar satellite orbit of Able-4 Atlas, and the heliocentric orbit of Able-4 Thor. The application of the system to a particular vehicle, the Able-4 Atlas space probe, will be described.

Because of its relatively high efficiency and its availability, the silicon photovoltaic cell was chosen as the device for conversion of sunlight to electricity in the power supplies for the Able space probes.

Once silicon solar cells in conjunction with storage batteries had been chosen as the power source, several design problems had to be met. It was clear almost from the first conception of the vehicle that the cells would have to be mounted externally to the shells of the payloads. To cover any significant fraction of the payload shell with solar cells would complicate the temperature control problem of the payload, and to obtain the required 30 watts of power for the payload a greater area for solar cells was needed than

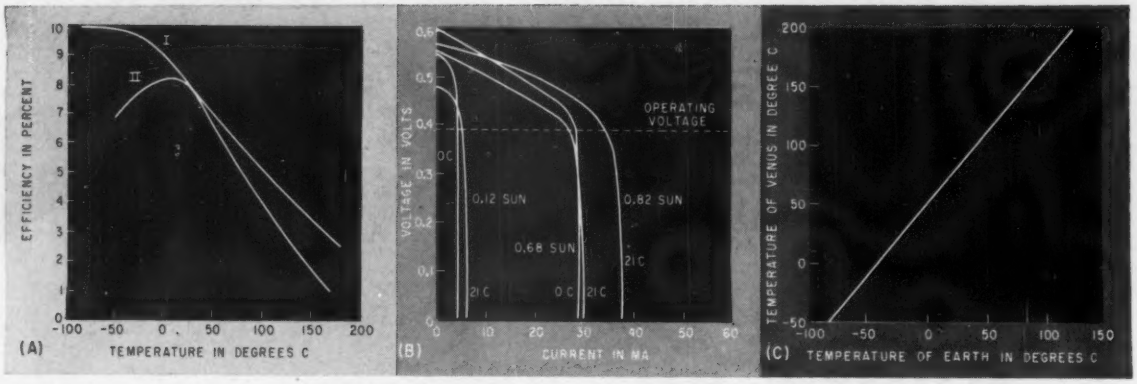


FIG. 2—Temperature effect on efficiency (A) and on current-voltage characteristics of 8 per cent silicon cells (B). Expected temperature at Venus is compared to measured temperature at earth (C)

the shells conveniently supplied. Hence, it was decided to use paddles extending radially from the equator of the vehicle, with the solar cells cemented to their surfaces.

The geometry of a silicon cell is illustrated in Fig. 1. Length and width of the unit are limited by the size of the crystal from which the cell is cut and by the need for high collection efficiency at the electrodes. Thickness should be small to minimize resistance in the n material. This is not a design problem since resistance can be kept below 0.25 ohm with thicknesses in the range of 0.1 to 0.5 cm. A more critical dimension is the thickness of the p layer. Since the large majority of hole-electron pairs produced by sunlight are created within one micron of the surface, two contradictory demands are made on the p layer: a thick layer reduces its resistance but a thin layer reduces the loss by recombination since the volume through which the freed electron must move without encountering a hole is thereby reduced. For cells of the size used in the Able programs (1 by 2 cm) optimum p-layer thickness is approximately one micron.

Cell Construction

In very general terms, a silicon solar cell is constructed in three steps. The crystal ingot is carefully grown in a melt into which arsenic is introduced as an impurity. Individual cells are then sliced from this ingot and shaped to the desired thickness. These cells are then diffused with boron from the gas of a boron compound and the boron impregnation removed from the bottom and all sides of the cells. The arsenic impurity serves therefore to define the n material and the boron the p layer for the p-n junction.

Temperature Dependence

Silicon solar cells suffer a loss of efficiency with increased temperature at the rate of about 0.6 percent per degree C above room temperature. Efficiency increases with lower temperatures, but the rate of increase is effectively zero as the temperature approaches about −100 C. Typical curves of efficiency plotted as a function of temperature are given in Fig. 2A; in curve I the load impedance is optimized for each temperature, while in curve II the load impedance is optimized at a fixed temperature (25 C).

It is known empirically that the open-circuit voltage decreases and the open-circuit current increases nearly linearly with increasing temperature. The short-circuit current, however, rises at a rate of only about 0.07 percent per degree C, a rate small enough to be ignored in practical applications. Figure 2B illustrates these effects by plotting voltage-current curves for two temperatures at different light intensities. These curves show that current is nearly independent of voltage just below the knee of the I-V curve.

The temperature of silicon cells mounted on a vehicle surface depends on several factors: radiation both to and from the cells and within the payload shell; conduction between payload components and parts of the non-isothermal shell; and power dissipation, both continuous and intermittent, within the payload. With the cells mounted on paddles, this thermal isolation from the payload is sufficient so that the energy balance at the cells can be closely approximated by considering only the effects of radiation.

By careful design to reduce the conduction loss through the paddle, the temperature of the solar cells on the back face can be made to approximate the temperature of the cells on the illuminated face so that the back face will radiate at the same temperature as the front. The temperature, T, of the cells can then be closely approximated by the expression

$$T^4 = \frac{\alpha G A_p}{\epsilon \sigma 2A_s}$$

where α is the absorptivity of the material integrated over the out-of-the-atmosphere solar spectrum, and modified for this purpose to be the fraction of incident solar energy absorbed but not converted to electrical power for the material, ϵ is the emissivity of the surface material defined as the ratio of the energy emitted by the material at its own temperature to that which would be emitted by a black body at the same temperature, G is the solar energy per unit area at the location of the satellite, σ is the Stefan-Boltzmann constant, T is the absolute temperature, A_p is the area intercepted by the sun's radiation, integrated for a rotating body and A_s is the surface area.

The temperature will change, of course, with G, the solar energy per unit area. The sun's intensity at the orbit of Venus (0.72 astronomi-

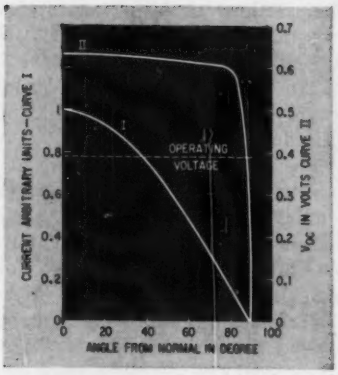


FIG. 3—Electrical characteristics are for cells rated at 8 percent efficiency at 0C

cal unit from the sun), for example, is about 1.9 times that of the earth. Thus on a trajectory reaching Venus the temperatures attained as compared with the temperatures near the earth are as shown in Fig. 2C. A solar cell power conversion system which would operate satisfactorily at the orbit of the earth may reach sufficiently high temperatures at the orbit of Venus to cease functioning unless some active cooling is employed or unless the cells are made to operate at a temperature sufficiently low at the earth so that they will still perform satisfactorily at the orbit of Venus.

Low Ratio Desired

It is clear from the previous expression that a low value of the ratio α/ϵ is desired to achieve a low cell temperature. Unfortunately, this ratio for a silicon solar cell is high; the absorptivity, α, is about 0.94 and the emissivity, ϵ, is only about 0.31 because silicon is semitransparent in the infrared and the emissivity of the upper surface of the metallic bottom layer of the cell is low. Emissivity can be raised by cementing glass plates to the silicon cell face or by spraying or vacuum-depositing suitable optical coatings. Effective absorptivity can be lowered by applying an interference filter which reflects a portion of the solar spectrum outside the region of electrical sensitivity of the cell, 0.4 to 1.1 microns. In addition, the temperature of the cells can be further reduced by coating the paddle area that is not active cell area with a material with a low ratio of α/ϵ.

It is not necessarily advisable, however, to attempt to achieve the lowest possible equilibrium temperature for the silicon solar cells, since the design of the solar cell array tends to permit a very rapid temperature drop when the payload is in eclipse. Good design will permit the cell-glass-cement assembly to withstand quite low temperatures but a point is reached where internal stress cracks the cell itself. Temperature decrease during eclipse can be reduced by increasing the weight of the array and by decreasing the over-all effective emissivity of the array, both of which, however, compromise other aspects of the design. For the Able vehicles, the trajectories and orbits are carefully planned to minimize eclipse time and delay the onset of long eclipses. In an eclipse lasting an hour, the temperature of the cells will drop to −165 F. Silicon cells can survive this temperature but longer eclipses could cause damage.

Power Output

The solar radiant power density at sea level on a clear day with the sun at the zenith is about 100 mw/cm². Silicon cell power units having an output under these conditions of 8 or 9 mw/cm² have been constructed, giving efficiencies of approximately 8 percent. Outside the atmosphere of the earth, the power from the sun is about 1.4 times that on the surface of the earth. However, much of the sun's energy absorbed by the atmosphere is in the ultraviolet and violet wavelengths, wavelengths which are almost unusable in solar cells because of reflection and the fact that the excess energy in each quantum serves only to heat the cell. Thus the power density when atmospheric absorption is no longer a factor is about 1.2 of that on the surface of the earth, or 120 mw/cm². Consequently on space vehicles in vacuum near the earth, cells of 8-percent efficiency at normal incidence to sunlight can generate about 10 mw/cm².

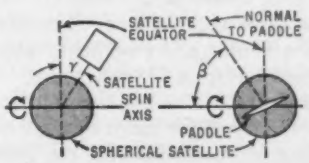


FIG. 4—Angles affecting projected area are defined

In general, the power from the solar cells charges storage batteries, or storage batteries regulate the voltage. Thus, the operating voltage of the solar cell is that of the battery plus the voltage across the diode used to isolate the strings of cells from each other. The isolating diode is required since the impedance opposite to the direction of current is very low when a string is in shadow.

The number of cells in series must be carefully selected so that the open circuit voltage of the string of cells is greater than the operating voltage imposed by the battery, assuring that the battery will be charged whenever the current is not negligible. At the same time the operating voltage must not be far below the open-circuit voltage or near-maximum power will not be realized. The importance of having a slow variation of open-circuit voltage with light intensity is thus clear. These requisites are made clear by Fig. 3, which shows the current output of a cell and the open-circuit voltage per cell as a function of the angle of incidence of sunlight. As long as the open-circuit voltage is greater than the operating voltage, the power output is the product of operating voltage and current.

Configuration

Under the actual operating conditions of a vehicle in space, the specific arrangement of the solar cells defines in large measure the actual power available to the vehicle. If the configuration places all available solar cells in a plane perpendicular to the normal incidence of sunlight, maximum power will be provided, assuming that the temperature is kept sufficiently low. The attitude of the vehicle with respect to the sun is constantly changing.

As a result, unless an active sun-seeking attitude control system is operating on the solar cell configuration, the angle of incidence on a single-plane configuration will reach zero at some point in a trajectory. Active attitude control systems would have necessitated additional weight and complexity that were not possible in the Able-3, -4

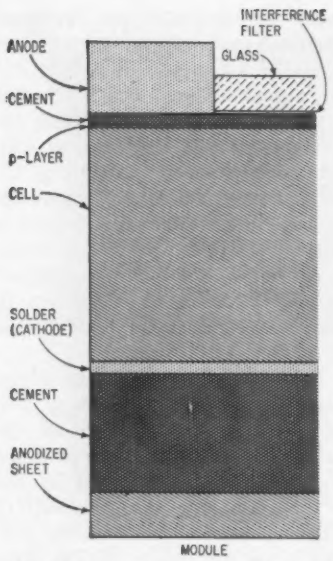


FIG. 5—Cross section (to scale) of solar cell shows relative thickness of layers

programs, and, so far as possible, continuous operation of the power source is needed. A configuration which is relatively insensitive to vehicle attitude and which, except for total eclipse of the vehicle, will continue to provide power to the vehicle is required.

For a spin-stabilized vehicle (as are all three Able space probes) it is convenient to consider the average projected area as a function of the sun's angle of incidence to the spin axis. When the cells are mounted on paddles, the problem is exceedingly difficult to analyze, for the shadowing of paddle on paddles and vehicle upon paddle must be considered. However, it can be shown that the projected area of the paddles as a function of the orientation spin axis with respect to the sun can be defined in terms of two angles, as shown in Fig. 4.

Able-4 Design

The power conversion system in an Able space probe must withstand several types of loads and must operate within certain limitations. During launch it must survive strong acceleration and vibration loads. The paddles must erect, latch firmly into place and begin to operate in a period of one second. The system must withstand the centrifugal loads created by a spin rate of nearly 3 rps. After spin-up and erection, it must withstand a third-stage acceleration and vibration with the paddles erected. After surviving these loads it must operate reliably and effectively for months.

The basic unit in the solar power conversion system in the Able-4 Atlas payload is a strip of five boron-diffused silicon solar cells measuring 1.78 by 0.79 inches and manufactured by Hoffman Electronics. The five cells are electrically connected by shingling, as illustrated in Fig. 1. Each strip exposes an area of 1.347 square inches or 8.69 square centimeters.

In the three Able vehicles, 0.003-inch glass plates are cemented individually to each cell, using a highly transparent cement and taking care to avoid an air or vacuum space between the glass and the silicon cell, thus preventing the temperature rise that would occur as the result of the greenhouse effect. An ultraviolet interference filter, centered at a wavelength of 0.49 micron, protects the cement from degradation by ultraviolet radiation and at the same time aids in temperature reduction by eliminating the energy in a portion of the solar spectrum. Further reduction could be achieved by reflecting the near infrared (1.1 to about 3 microns) but this was not done for the Able vehicles. A cross section of the layers in the solar cell is shown in Fig. 5. The wavelength properties of the incident solar radiation, rejected radiation, and converted radiation in the cell are shown in Fig. 6.

The strips are connected in series, as shown in Fig. 7, on the anodized outer surface of both sides of a tapered block of honeycomb aluminum. The epoxy glue used serves also to insure insulation from the aluminum should the anodized layer become scratched. Ten of these strips form a module, with a maximum weight of about 90 grams. Honeycomb aluminum meets the three requirements of strength, light weight, and good heat transfer characteristics. Subdividing the structure of the paddles into modules allowed for more efficient handling of the paddle. If the paddle were a single indivisable unit, damage to a cell after its inclusion on the paddles would necessitate removing the cell and very possibly damaging the honeycomb beneath it. In that case the whole paddle would have to be replaced rather than just a module.

The modules are attached to a central tube with 11 modules extending to each side, separated by a distance of 0.2 inch to prevent the possibility of mutual damage during vibration or deflection under load. The tube extends three inches beyond the last module to permit attachment and support during first and second stage firing. With 22 modules to a paddle, 2,200 solar cells are carried on each paddle, 1,100 facing to each side. Thus, 8,800 cells are included in the system.

The paddles are bolted to the four arms on the payload at an angle rotated counterclockwise 33 degrees on the axis of the paddle. In the erected position the paddles form an angle of 60 degrees with respect to the payload's equator (as defined by the spin axis). The arms are paired such that two extend up from the plane of the equator at an angle of 22.5 degrees and two extend down at the same angle. (The 60- and 22.5-degree angles are the β and γ defined in Fig. 4.). The configuration of the paddles established by these angles results in the equivalent of 25 percent of the cells normally oriented to the sun at all times. This configuration results in a projected area which varies no more than about 10 percent regardless of the sun's position. In arriving at the angle of 22.5 degrees a compromise had to be

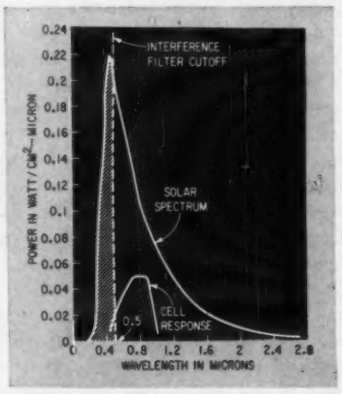


FIG. 6—Power as a function of wavelength for solar spectrum and solar cell response above earth's atmosphere

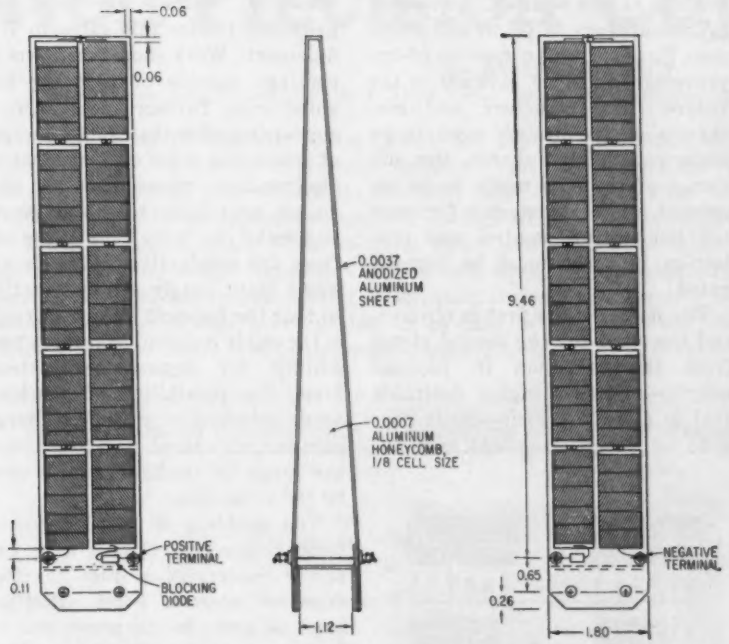
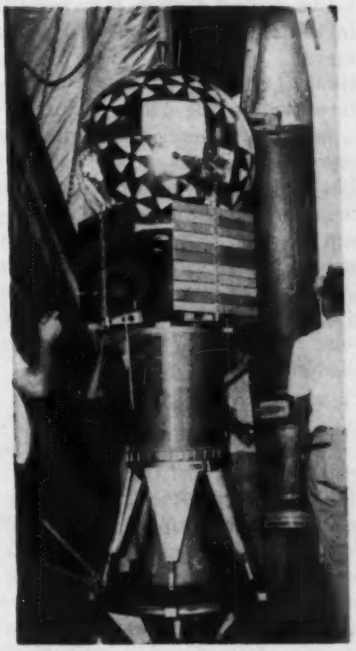


FIG. 7—Dimensions of solar cell module shown in inches. Use of modules simplifies problem of replacing damaged cells



Paddles are shown folded back, as they will be during launch

reached between maximum exposure for the cells and stability of the spin axis. Placing the paddles alternately 45 degrees up and 45 degrees down would have produced minimum shadowing of paddle on paddle but would have had the effect of creating equal moments of inertia about two axes of the payload, thus creating the danger of wobble after spin-up.

During launch the paddles are folded vertically in a symmetrical fashion about the Stage 3-4 connecting structure. The tips of the paddles rest in sponge rubber on brackets mounted on the interstage structure and are held in place by a prestretched dacron cord encompassing all four paddles. The paddles are held down against torsion-spring tension at the hinges. When the cord is released, the torque of 19 inch-pounds applied by these steel springs raises the paddles. A separate spring-loaded cam in the arm mechanism locks the paddles in place.

The release and erection mechanism is activated during the coast period before spin-up by an explosive cutter through which the cord is threaded. A timer in the second stage ignites this cutter at the proper moment, to drive a knife-edge piston through the cord, severing the cord and releasing the paddles.

It is important that the paddles erect at this moment. To permit their erection during first or second stage burning would have required very heavy springs on the paddles to overcome the g-loading imposed by the acceleration. To erect after spin-up, the initial force of which is large, would have imposed a contradictory difficulty, because of too much erection force on the paddles. The centrifugal force created by spin would swing the paddles out with damaging force at latch unless fluid dampers or some form of plastic impact were incorporated. It is essential that the paddles erect to an accurate position to insure dynamic balance within close limits.

Electrical Design

With this configuration in orbit about the moon a nominal constant charge current of 1.6 amperes (about 30 watts) could be provided by the paddles. Of this current, approximately 0.85 ampere is needed for the constantly operating electronics in the sensing and recording equipment associated with the scientific experiments. Thus 0.75 ampere is available to charge storage batteries. These batteries consist of two packs of 14 nickel-cadmium cells each, attached in series. When the 5-watt transmitter in the vehicle is operating, it draws about 2.8 amperes from the system, and therefore during its operation the net drain on the batteries is about 2 amperes.

At this rate the batteries require approximately four hours for discharge as compared to 12 hours for maximum charge. Since complete discharge of the batteries is not desirable, the charge-discharge rates must be carefully watched during flight to try to prevent the voltage from dropping below 17.5 volts. Moreover, an emergency undervoltage cutout is included which automatically turns off the transmitter should battery voltage drop to 15.5 volts. The exact duty cycle is chosen after the vehicle is in flight, on the basis of the telemetered charge current and payload temperature.

Consideration must be given to control of the temperature of the batteries, since their efficiency decreases at a rate of approximately one percent for every 4 degrees F that the temperature increases or decreases in the neighborhood of the optimum of about 70 F. The

active control system incorporated in the design of the Able-4 Atlas served therefore, among other things, to keep battery temperatures within the proper range.

A simplified block diagram of the power supply system is shown in Fig. 8. The switches which activate the solar cell power conversion system are closed when the paddles swing into place. Blocking diodes separate the charge current from the discharge current and isolate solar cell strips when they are shadowed.

Operation

At launch the batteries are maximally charged, and thus the operation of the transmitter during the immediate postlaunch period imposes no hardship on the power system. However, once initial tracking has established an accurate trajectory and initial telemetry has provided data on paddle activation, charge current, and payload and paddle temperatures, it is necessary to plan transmission times from the vehicles so that the system will not be overloaded.

One payload transmitter can be operated about 30 percent of the time, but the exact duty cycle must be determined after special experiments have been performed with specific battery charge and discharge cycles, and measurements have been made of transmitter temperatures. When fully charged, the batteries in the payload can operate a 5-watt transmitter for slightly more than three hours. By that time, however, the battery voltage is reduced to a level which actuates the undervoltage control, automatically turning off the transmitter and performing the other functions that a ground *Transmitter Off* command would cause.

The Space Navigation Center (Span) at Space Technology Laboratories controls this duty cycle.

Future Developments

The Able-3 earth satellite (Explorer VI), launched in August 1959, carries a solar cell power conversion system very similar to the one described here. The system has operated satisfactorily. The conclusion, then, is that the general application to power supplies in space vehicles of this solar cell conversion system appears to be an acceptable one. However, three avenues of improvement must be pursued in the future. The structure and mechanics of the system need to be made completely reliable, the efficiency of the cells needs to be increased, and new materials for solar cell temperature control and protection in space must be investigated.

The need for the first is obvious, and the need for the second stems from the reduction in payload weight—always a highly desirable goal in a space vehicle—made possible by the concomitant requirement for fewer cells. The third need stems from the fact that as space exploration becomes more ambitious, with interplanetary ranges and lifetimes of several years desirable, present α/ϵ control and surface protection for solar cell arrays may be inadequate.

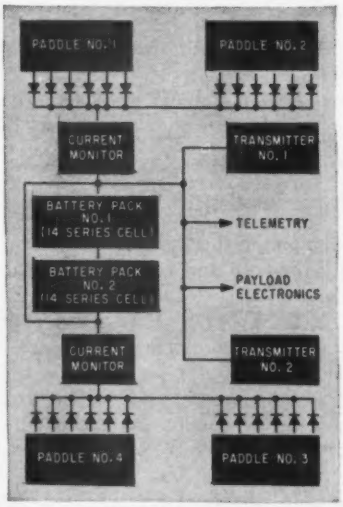


FIG. 8—Transmitter and battery-charging cycles are controlled from ground

The energy lost in the conversion in solar cells of solar radiation to electrical power results principally from four factors: reflection; recombination; the forward leakage current through the converter; and the fact that the photon energy greater than that required to produce hole-electron pairs does not contribute to useful output.

Untreated silicon solar cells reflect about 10 percent of the incident sunlight in the wavelength range of value. Surface treatment can presently reduce this value to 7 or 8 percent. Work should continue on coatings capable of reducing this value even further. Moreover, it appears possible that the technology of preparing solar cells can reduce electron-hole recombinations that do not contribute to usable power and make the transition in the cell from one conductivity type to another more nearly a step junction so that the forward leakage current in the cell is reduced. A further possibility for improvement stems from the possibility of stacking semiconductors of differing energy gaps in such a manner as to increase the range of sunlight energy used by the solar cells.

The problem of protection and temperature control of a solar cell power conversion system has two areas of interest. First, attention must be given to the prevention of damage to the system during long periods of eclipse. Obviously it will be impossible to keep eclipse times to periods of an hour or less on all future space vehicles, and hence procedures for assuring that the system can survive long eclipses must be devised.

Second is the problem of preserving the radiation balance of the various surfaces involved in the conversion system. Long exposure of these to the unfamiliar but doubtlessly destructive stresses of the space environment may very likely change the surface optical properties and degrade the operation of the system. In this environment molecular bonds are broken and glass is darkened by ultraviolet and even more penetrating radiations; hard radiation can damage the electrical performance of the cells; materials sublime and evaporate significantly over long intervals of flight in the hard vacuum; stray atoms and molecules cause sputtering of the surface; and micrometeorites pit and erode the surface, particularly glass coatings on cells, and may partially cover the surface with the debris of the impacting particles. The combined effects of these stresses may serve to enhance each other. All of these changes in the surface are reflected in changes in the radiation properties of the surface material.

Non-Precision Capacitors

By ALBERT LUNCHICK,
Capacitor Development Unit, U. S. Army Signal Research and Development Laboratory, Fort Monmouth, N. J.

RAPID PROGRESS in capacitor development has produced a varied array of types and designs. This creates a situation where optimum choice of capacitors for a particular application could be overlooked.

Table I lists various types of electrolytic and general-purpose ceramic capacitors. These two categories are included in one tabulation because their broad tolerance makes them usable as by-pass or filter capacitors where bulk capacitance of guaranteed minimum value is needed. These applications do not require the low dissipation factor, stability and high insulation resistance values found in precision and semiprecision capacitors.

The table includes those styles most likely to be encountered and does not preclude the use of less common or special types which are commercially available. The table lists only those parameters which permit ready comparison.

Table I—Nominal Characteristics of Electrolytic and General-Purpose Ceramic Capacitors (25 C)

	MIL Spec	MIL Style	Temp. Range Deg C	Volts D-C	Capacitance μf	Insul. Res. Limit (Megohms)	Max. % Cap. Var. with Temp.	Diss. Factor Limits (%)	Polarized	Volumetric Eff. (μf/in.³)	Remarks
Electrolytic											
Aluminum	C-62	CE	−40 +85	15–450	4–2,000	<3	+15 −75	15–50	yes	5–450	Two-year shelf-life limit
Tantalum	C-3965	CL24	−55 +85	15–150	1–580	0.5–30	+50 −40	15–20	yes, no	55–1,900	Etched foil, wet
Tantalum	C-3965	CL34	−55 +85	3–150	0.5–300	0.2–40	+25 −45	15–25	yes, no	25–1,000	Plain foil, wet
Tantalum	C-3965	CL44	−55 +85	6–125	2–60	6–40	+30 −50	4–25	yes	75–1,300	Wet, sintered anode
Tantalum	C-3965	CL15	−55 +175	18–630	4–240	0.2–15	+40 −60	5–45	yes	3–600	Wet, sintered anode, double cased
Tantalum	C-55057 (Sig C)	CS12	−55 +85	6–35	0.1–68	0.5–400	±10	3–6	yes	30–6,000	Dry, sintered anode
Aluminum (axial leads)	6410[b]		−40 +85	150–450	5–20	<10	+15 −50	15	yes	35	High-purity foil, tubular can
General-Purpose Ceramic											
Ceramic[a]	C-11015	CK6	−55 +85	500	0.00047 0.01	>10,000	+30 −80	3	no	<0.2	Plate or disc
Ceramic[a]	C-11015	CK2	−55 +85	500	0.0001 0.0047	>10,000	+30 −80	3	no	<0.1	Tubular
Cerafil[a]	6407[b]	CK1	−55 +85	100	0.001 0.047	>10,000	+10 −25	2.5	no	<4	Aerovox trade name
Stable[a]	6401[b]	Char. X	−55 +85	500	0.00022 0.0047	>10,000	±15	1.5	no	<0.1	Plate, disc or tubular
Feed-through, Stand-off	6406[b]	——	−55 +85	500	0.00047 0.002	>10,000	+30 −80	2	no	<0.1	High-frequency bypass
Monolythic[a]	——	——	−55 +85	25	0.075 0.75	>10,000	+30 −80	4	no	3–25	Sprague trade name
Ceramic[a]	——	——	−55 +85	75–150	0.001 0.01	>10,000	+30 −80	3	no	<0.5	Plate or disc
Stable[a]	——	——	−55 +125	50	0.001 0.1	>10,000	+10 −15	2	no	15	Under development
Fluorinated[a]	——	——	−55 +200	50–500	0.0001 0.01	>50,000[c]	——	3	no	——	Proposed prod. development

(a) High dielectric constant (b) Signal Corps technical requirements (U. S. Army Signal Research and Development Lab). These spec numbers prefixed by SCL. (c) Insulation resistance limit >5,000 at 200 C

Digital Control of Machine Tools

Thyratrons control a milling machine by driving step motors in response to signals from a programmed tape

By **A. G. THOMAS,** Charlottesville, Virginia

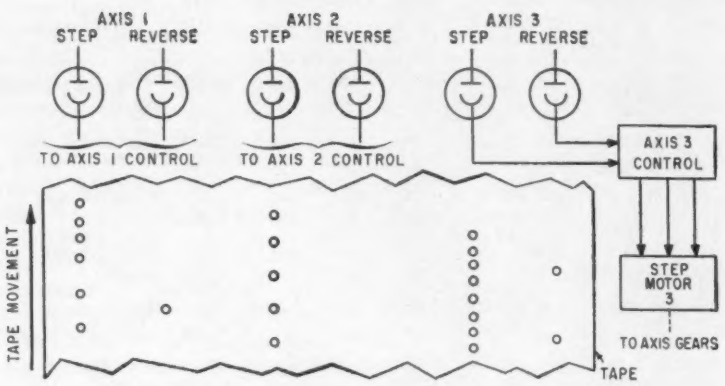


FIG. 1—Pictorial representation of system. Tape moves in plane between phototubes and a light source which is not shown

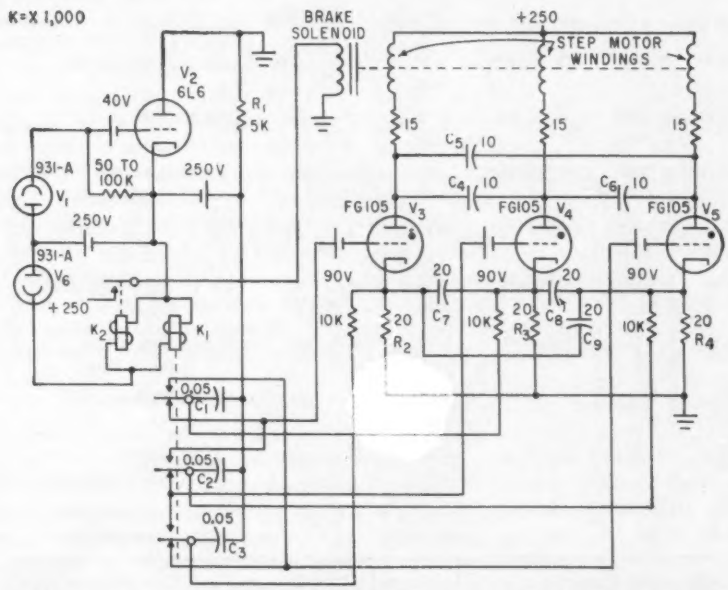


FIG. 2—These circuits control one step motor. The 1-Kv supply for phototubes V_1 and V_6 is not shown

IN THE SYSTEM to be described, three step motors drive the table, cross feed, and knee-elevating mechanism of a milling machine. These motors move one step at a time in response to pulses supplied by tape-controlled thyratrons.

Overall Operation

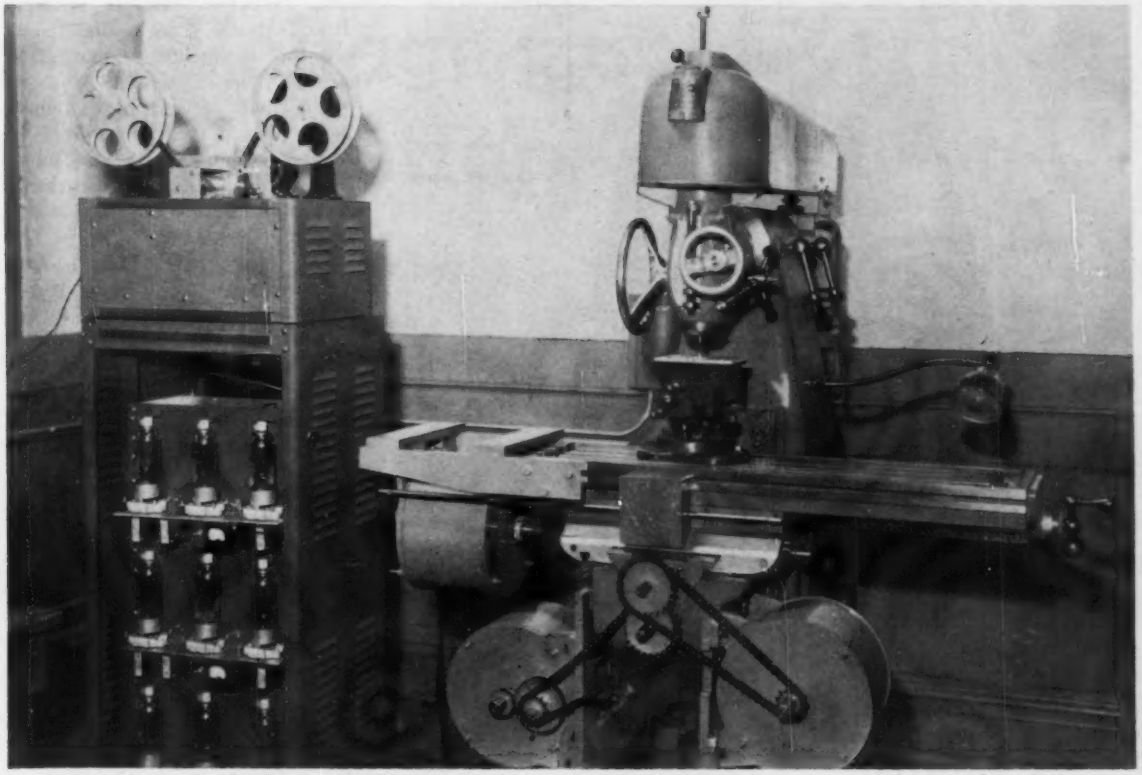
Figure 1 gives a simplified picture of the system. Control information is in the form of punched holes in the tape. These holes modulate a light source (not shown in Fig. 1) which is directed to six phototubes.

Each pair of phototubes controls movement in one of the three axes of movement of the milling machine. For example, consider movement in axis 3. Each light pulse to the STEP phototube of this axis pulses the axis 3 control circuit. This control circuit pulses step-motor 3, rotating it forward or backward over a discrete arc. Gearing transforms step-motor rotation into axis movement. Light passing through a reverse-signal hole pulses the REVERSE phototube, which signals a reversing circuit of axis 3 control; thus the step-signal hole following the reverse-signal hole steps the motor in the reverse direction.

Identical axis-control circuits, which are not shown in Fig. 1, produce movement in axes 1 and 2.

Control Circuits

Each axis is controlled by a circuit identical to that shown in Fig.



The milling machine's electronic operator at the left gets its instructions from the tape above

2. This figure does not show the light source or the tape that modulates the light directed to phototubes V_1 and V_6.

Phototube V_1 is connected in the grid circuit of negatively-biased tube V_2. A step light pulse to V_1 causes V_2 to pass current through resistor R_1.

The voltage pulse across R_1 passes through capacitances C_1, C_2 and C_3. The grids of thyratrons V_3, V_4 and V_5 receive these pulses through the contacts of relay K_1.

These thyratrons are negatively biased, except for any thyratron which happens to be fired. Because of the cathode-connected resistors R_2, R_3 and R_4, and the tying of these resistors to the grids of other thyratrons, a conducting thyratron applies a positive potential to the grid of the thyratron that is next in the firing order, but without a sufficiently positive potential to fire it.

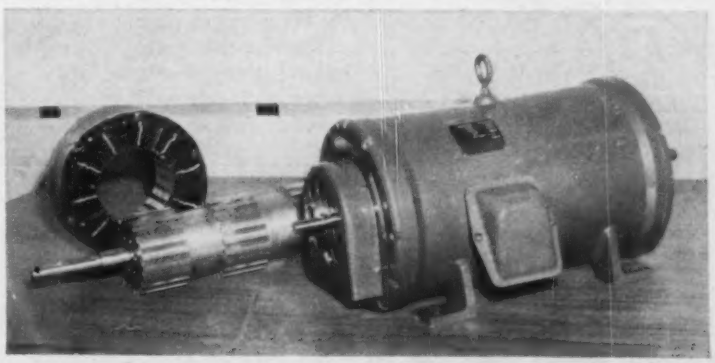
When the next step pulse from phototube V_1 is applied to all the grids of the thyratrons, only the tube whose grid potential has been raised fires, since the firing pulses are not sufficiently positive to overcome the full negative-bias potentials at the grids of the other thyratrons. Thus, successive pulsing of the grids of V_3, V_4 and V_5 causes them to fire, sending successive pulses through the step-motor field windings.

Capacitors C_4, C_5 and C_6 quench the current of a thyratron when the next thyratron in the firing order fires. By using additional cathode-connected quenching capacitors C_7, C_8 and C_9, the capacitances of C_4, C_5 and C_6 are considerably reduced. Thus harmful currents circulating through the motor windings are reduced and better speed and more stable operation are attained.

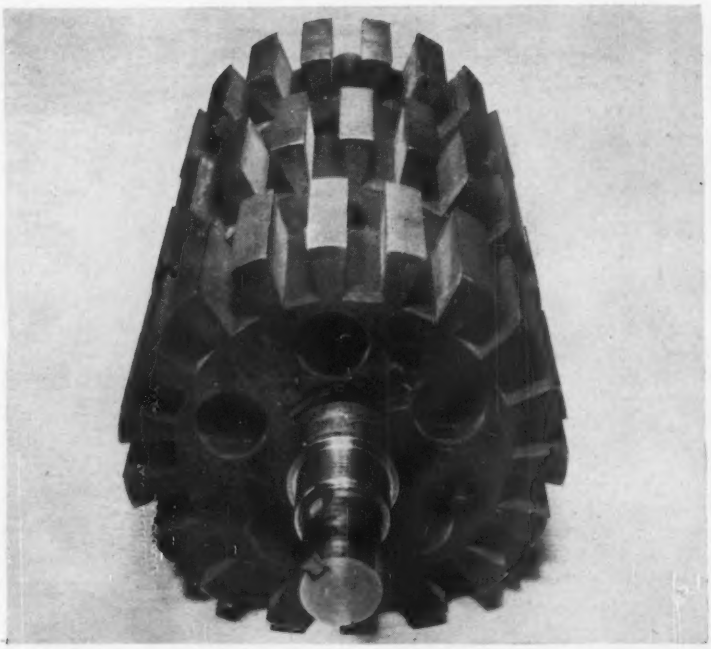
Reversing Rotation

Reversal of step-motor rotation occurs when a punched hole in the tape delivers a light pulse to phototube V_6. This tube passes current through relays K_1 and K_2.

Relay K_2 pulls in, energizing the brake solenoid, which prevents the



Disassembled step motor shows only one of the field windings



The rotor is essentially three rotors in one, all mounted on the same shaft and each displaced by a predetermined amount

step motor from moving in the direction opposite to the desired direction; before the solenoid is energized, the brake allows step-motor travel only in the forward direction.

When relay K_1 pulls in, it switches the cathode connections of each tube so that firing order is reversed. For example, with K_1 deenergized, and V_3 conducting, V_5 would be the next tube to fire; with K_1 energized and V_3 conducting, V_1 is the next tube to fire.

Step Motors

The step motor is the heart of the milling-machine control system and makes possible many simplifications. Early models of this motor were irregular in operation, sometimes suddenly jumping in the forward or reverse direction and at other times suddenly coming to a halt. These effects were due to the resilient magnetic system; as the field poles of the three sections (phases) were sequentially magnetized, the associated rotor poles would be strongly accelerated by magnetic attraction and would oscillate about the in-register position. That is, as the next field section was energized, the rotor might be travelling forward; the added forward pull might cause the rotor to jump several steps. Similarly, the rotor might be travelling backwards at the moment a field section was energized, so that the forces on the rotor would virtually cancel.

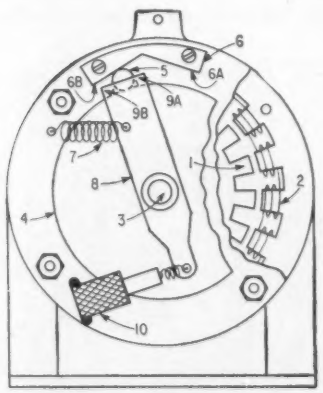


FIG. 3—Brake mechanism of step motor

To solve this problem, a one-way locking device was attached to the motor and arranged to engage a brake disk at an appreciable radius from the axis of the shaft. This arrangement allows free rotation of the rotor in one direction but quickly locks the rotor against movement in the opposite direction. The reverse lock takes effect almost instantly at the greatest displaced position of the rotor, at which time its velocity is virtually zero. Therefore braking is done without shock. The brake drums show no appreciable wear after many millions of steps.

Each field section has equally-spaced poles which are wound to produce alternate north and south poles when supplied with current.

The stators are set up so that the poles of the three sections are phased (staggered). That is, the arc covered by the trailing edges of the poles of one stator section is covered by the leading edges of the poles of another stator section. Rotor teeth, which are equally spaced so that they line up below stator poles, are in alignment from section to section.

Figure 3 shows a cutaway view of the motor. Part of a rotor section (1) and part of a stator section (2) are visible. Attached to the motor shaft (3) is a brake disk (4) which locks roller (5) against the hardened surface (6b) of cam (6) if the rotor tends to rotate in the counter-clockwise direction. Tension spring (7) normally holds arm (8) in the position shown. The rotor is free to rotate clockwise.

Roller (5) is caged between arms (9a) and (9b) which extend from bar (8). This bar is rotatable through a limited angle around the motor shaft (3).

When rotation of the motor is to be reversed, solenoid (10) is energized. The solenoid rotates bar (8) clockwise until roller (5) is pinched between disk (4) and cam surface (6a). The disk and rotor are then free to rotate in the counter-clockwise direction but are prevented from rotating in the clockwise direction. Consequently, the brake prevents oscillation of the rotor for both forward and reverse rotations.

System Characteristics

Workpieces have been automatically milled for tolerances of 0.001 inch. No markings due to the step action are visible in the finished product. Movement per step can be set at any value desired by choosing the correct gear ratio but the finer the tolerance, the slower the workpiece movement. An electromechanical device encodes the signal-conveying information contained by the punched holes of the tape.

Voltage-Controlled Bootstrap Generator

By combining a flip-flop and a bootstrap sweep generator, the output pulse length can be varied by a d-c bias or control voltage

By JOHN B. PAYNE III, Hughes Aircraft Company, Culver City, California

PHANTASTRON CIRCUITS are used to generate sweep signals, gating pulses and time delays. The circuits are popular because they are simple and reliable. Bootstrap sweep circuits can be made to generate the same type of waveforms as the phantastrons and they have a further advantage: the bootstrap circuits can be transistorized.

A typical phantastron circuit, such as that shown in Fig. 1, cannot be duplicated with any single transistor available today. The characteristics necessary for phantastron operation—sharp cutoff with both g_1 and g_2 grids—are available in such tubes as the 6AS6, 5915, etc., but not in transistors.

Definite savings in size, weight and power are realized when transistors are used in bootstrap circuits. The multipurpose bootstrap circuit uses a minimum number of transistors yet generates several waveforms. One output is a rectangular pulse or gate whose duration is directly proportional to the level of the input control signal. A second waveform is a sweep with constant slope but controllable amplitude or duration. In addition, a highly linear sweep with a variable slope can be obtained.

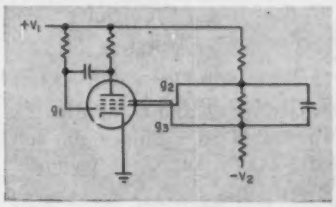


FIG. 1—Screen-coupled phantastron circuit supplies its own gate after being triggered

Circuit Operation

The basic circuit consists of a bootstrap sweep circuit coupled to a binary flip-flop, shown in Fig. 2A. The coupling is such that the binary is reset when the output sweep voltage reaches a specified level. This level V_A is variable, and thus the amplitude of the sweep can be changed. Because the slope of the output wave is not a function of the control voltage the duration of the wave is also controlled by this voltage. Since the gate output signal and the sweep signal are complementary, the duration of the gate is the same as the duration of the sweep, and thus controllable by V_A.

The basic bootstrap sweep circuit in Fig. 2A consists of transistor Q_3 and its associated components R_1, R_2, C_1, C_2 and D_1. The object of the circuit is to produce a constant charging current to C_1, thereby producing a linear rise in voltage. At the beginning of the sweep, Q_2 is saturated, the charge on C_1 is zero, the emitter-to-ground voltage of Q_3 is zero and C_2 is charged up to V_{cc}. Capacitor C_2 has to be large compared to C_1, such that it loses very little of its charge during the sweep period. Operation of the circuit is such that C_2 can be considered to be a battery.

As the voltage across C_1 rises, the emitter voltage of Q_3 increases by

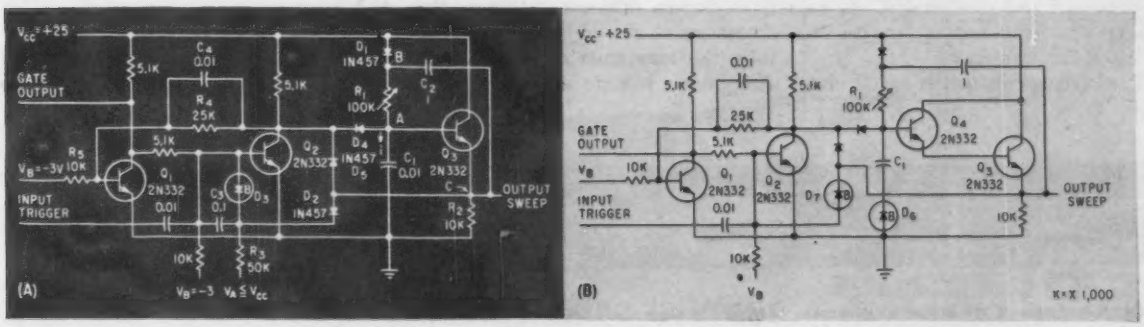


FIG. 2—Bootstrap circuit is coupled with flip-flop to give variable, controllable sweep (A). A highly linear version of the circuit has constant amplitude output and uses an extra transistor in the Darlington connection (B)

the same amount, since the voltage gain is almost unity. Because the charge on C_2 changes very little, the voltage across C_2 changes very little and the voltage at point B rises by the same amount as the voltage at point C. Point B therefore rises above V_{cc} but diode D_1 blocks current flow to V_{cc}. Since points A, B and C all rise in voltage by the same amount, the voltage drop across R_1 is constant; therefore charging current to C_1 remains constant and output voltage rises linearly.

The charging current will not be exactly constant because of secondary effects; the base current to Q_2 changes slightly, the emitter-follower gain is not exactly unity, and C_1 does lose a little charge. All these effects are small.

Flip-Flop

Transistors Q_1 and Q_2 of Fig. 2A are connected as a binary flip-flop with D_2, D_3, R_3, and C_3 as feedback for self-gating.

Prior to any trigger pulse, Q_2 is saturated, with its collector voltage approximately zero. Diode D_4 acts to discharge C_1 and clamp it to ground potential; Q_1 is biased to cutoff through the voltage divider formed by R_4-R_5 and its collector voltage is high, thus holding Q_2 saturated. Voltage V_a holds Q_1 cut off. At room temperature, the voltage V_a and resistors R_4 and R_5 can be eliminated; they are required at high temperatures, however. If silicon transistors are used, the hold-off circuits can be eliminated even at high temperature.

The circuit is triggered by a negative pulse arriving at the base of Q_2 driving this transistor to cutoff and throwing Q_1 into saturation, with C_4 acting as a speed-up capacitor. The collector of Q_2 rises, D_4 is back-biased and the top of C_1 is no longer grounded but is free to be charged through R_1.

The voltage drop across R_2 increases linearly until the sweep voltage reaches V_A, at which time D_2 is forward biased, driving the base of Q_2 positive. Zener diode D_5 is shunted across C_3 to insure that Q_2 is driven into saturation if the charge on C_3 should become greater than the maximum sweep voltage. The Zener voltage should be less than V_{cc} but at least as large as the maximum sweep amplitude required. As soon as Q_2 starts to conduct, the flip-flop will return to its initial conditions, in which the collector voltage of Q_2 goes to zero and discharges C_1 through D_4. Diode D_2 provides a low impedance path to ground for C_2 to recharge quickly to V_{cc}. The bootstrap sweep circuit is much less sensitive to changes in repetition rate because of the path provided by D_5.

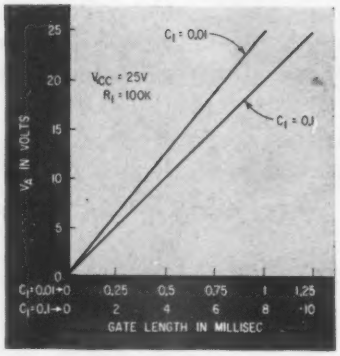


FIG. 3—The length of the gate is varied over a large span by controlling the bias voltage

EQUATIONS OF SWEEP TIMING CIRCUIT

The voltage across C_1 is given by

$$Vc_1 = \frac{1}{C_1}\int_0^t i\,dt \qquad (1)$$

$$\text{where } i = \frac{Vcc}{R_1} \qquad (2)$$

The rate of change of voltage across C_1 is

$$\frac{d\,Vc_1}{dt} = \frac{d}{dt}\left[\frac{1}{C_1}\int_0^t i\,dt\right]$$

$$= \frac{i}{C_1}\ (\text{volts/sec})$$

$$\text{or } \frac{d\,Vc_1}{dt} = \frac{V_{cc}}{R_1 C_1} \qquad (3)$$

The slope of the output sweep is $V_{cc}/R_1\,C_1$ in volts per second; sweep amplitude is V_A; gate time, which is also the duration of the sweep is $R_1\,C_1\,V_A/V_{cc}$.

Circuit Waveforms

By varying V_A, the sweep and gate lengths can easily be changed. The circuit of Fig. 2A was tested for various values of V_A to determine the effect on gate length, with the results shown in Fig. 3. Waveforms for two different values of V_A are shown in Fig. 4A and 4B, which show both the gate and the ramp functions.

Although the linearity is extremely good, as is shown in more detail in Fig. 4C, it can be improved further by adding another transistor to Q_2 in the Darlington connection, as is done in the circuit of Fig. 2B. The linearity that this extra transistor gives is shown in Fig. 4D, which can be compared with Fig. 4C by sighting along the page or by comparing with a straight edge.

A pedestal on the sweep, as in Fig. 4E, can be obtained by adding a Zener diode between C_1 and ground, as D_6 in Fig. 2B. The amplitude of the pedestal will be equal to the Zener voltage.

If a fixed sweep amplitude is desired, the circuit can be simplified somewhat. Thus Fig. 2A is simplified by replacing D_2, D_3, C_3, R_3, and V_A by Zener diode D_7, as in Fig. 2B.

REFERENCES

(1) J. Millman and H. Taub, "Pulse and Digital Circuits", p. 222, McGraw-Hill Book Company, N. Y., 1956.

(2) Chance, Britton, et al, "Waveforms," MIT Radiation Series, 19, McGraw-Hill Book Company, N. Y. 1949.

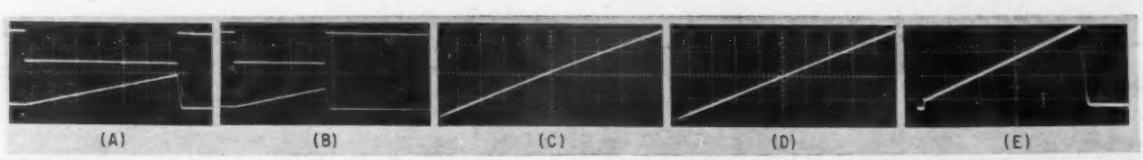


FIG. 4—Waveforms of the bootstrap generator. (A) and (B) show the effect of the control voltage V_A on the gate and ramp outputs. (C) is an enlargement of the ramp of Fig. 2A, (D) for Fig. 2B, showing the increase in linearity obtained from the Darlington connection. Ramp function on a pedestal is shown in (E)

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No. 133 65 10 001

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The socket provides two slots of different widths mating with two corresponding legs depending from the metal envelope of the tube to index the tube and socket contacts. As a result the tube can be inserted by feel only and it is impossible to insert the tube incorrectly or damage the contacts. The socket saddle provides spring elements that engage with the depending legs of the tube envelope thus grounding the envelope to the panel.

The socket body is of low loss phenolic insulation, Type MFE. The saddle is of cold rolled steel, cadmium plated. The contacts are of copper alloy with cadmium plating.

Although the contact tails are of sub-miniature size, an ample slot is provided for ease of soldering connecting leads.

ELECTRICAL RATINGS:

No. 133 65 10 001

	VOLTS AC RMS	VOLTS DC
VOLTAGE BREAKDOWN:		
Sea level (adj. terminals)	1600	2600
Sea level (to ground)	1800	3000
Altitude 3.4 in. hg. (adj. terminals) 50,000 ft.	500	800
Altitude 3.4 in. hg. (to ground)	600	900
VOLTAGE RATINGS:		
Seal level (adj. terminals)	550	850
Sea level (to ground)	600	1000
Altitude 3.4 in. hg. (adj. terminals) 50,000 ft.	160	250
Altitude 3.4 in. hg. (to ground)	200	300
RECOMMENDED WITHSTANDING VOLTAGE:		
Seal level (adj. terminals)	1200	1500
Sea level (to ground)	1300	1600
Altitude 3.4 in. hg. (adj. terminals) 50,000 ft.	350	600
Altitude 3.4 in. hg. (to ground)	450	700

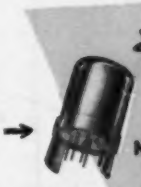
Current Rating: 1 ampere

Contact Resistance: 0.05 ohms Maximum

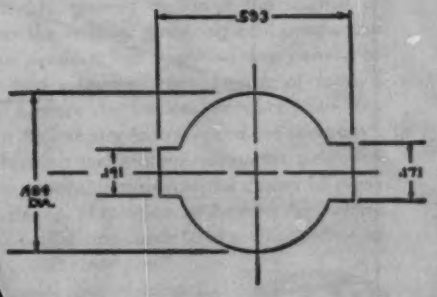
Insulation Resistance: 50,000 Megohms Minimum

Capacitance: Between one contact and all other conducting parts. .25 mmf Maximum

Electrical tests performed in accordance with EIA Standard RS-167.



The socket fits into a .484 diameter hole with two slots as shown below, and the two legs of the socket that fit into these slots fold over on the under side of the panel, this holds the socket securely in place.



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Helical Antenna Chart

Gain and beamwidth can be obtained with one setting of straightedge

By **HANS SCHARLA-NIELSEN and PAUL H. MOORE,** Radiation, Inc., Melbourne, Florida

NOMOGRAPH presented in Fig. 1 is a mechanization of the axial mode helical antenna design equation $G = 8.76 + 10 \log [(C/\lambda)^2 nS/\lambda]$.[1] The gain is relative to a linearly polarized isotropic antenna and holds for $\alpha = 12.5$ deg, $g > 0.8\ \lambda$ and $d \cong 0.02\ \lambda$. These terms are defined in Fig. 2.

As a first example, consider a helix measuring 69.5 in. in axial length from the ground plane, with a diameter of 6.7 in. and a turns spacing of 4.6 in. The gain at 527 Mc is found as follows. Get number of turns by dividing A by S, thus $n = 15.1$. The free space wavelength at 527 Mc is 22.4 in., so the helix diameter is 0.3 wavelength. Connecting the values of n and D indicates a gain of 13.3 db. Add 3 db for the gain relative to a circularly polarized radiator and subtract 2.2 db for the gain relative to a dipole. The half-power beamwidth is 32 deg.

For the second example, consider that a design is required for a helical beam antenna having a minimum gain of 8 db over the 216 to 260 Mc telemetry band. Diameter is to be held to a minimum. The lowest gain occurs at the lowest frequency, or when the diameter is the smallest fraction of a wavelength. Connecting 0.25 on the D scale with 8 db on the G scale indicates an axial length of approximately 1.37 λ. The gain at the high end of the band is found by multiplying the diameter (0.25 λ) and the length (1.37 λ) by the ratio of the high to the low frequencies (1.2). Diameter D then becomes 0.3 λ and the length becomes 1.65 λ. Connecting these points indicates a gain of 10.4 db.

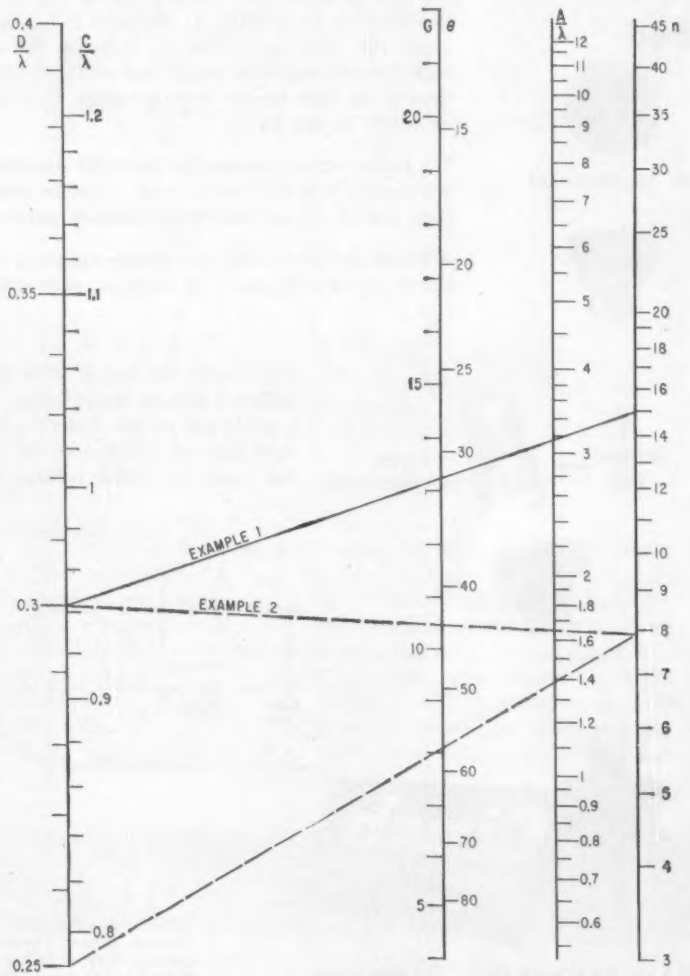

FIG. 1—Nomograph for determining antenna gain and beamwidth

REFERENCES

(1) J. D. Kraus, Helical Beam Antenna Design Techniques, *Communications*, 29, p 6, Sept. 1949.

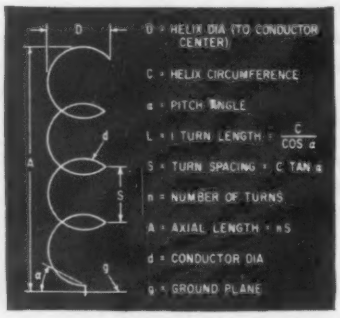
D = HELIX DIA (TO CONDUCTOR CENTER)
C = HELIX CIRCUMFERENCE
α = PITCH ANGLE
L = 1 TURN LENGTH = C/COS α
S = TURN SPACING = C TAN α
n = NUMBER OF TURNS
A = AXIAL LENGTH = nS
d = CONDUCTOR DIA
g = GROUND PLANE

FIG. 2—Definitions of helical antenna symbols

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SIZE 8—SERVO
TACHOMETER
TYPE SJ7HLZ7-4

High Performance
plus Low Tachometer Power

This small motor tachometer features high torque output per watt input and excellent signal to noise ratio. It is an ideal choice for those applications where space is limited yet the high performance and reliability of a precision damping, motor generator is required. Other BuOrd Size 8 motors, tachometers and gearhead units are available, built to E.A.D.'s high standards as well as to meet specific customer requirements.

TYPICAL CHARACTERISTICS

GENERAL: Frequency, 400 c.p.s. • Rotor Inertia, 1.2 gm.cm.^{2} • Torque at Stall, 0.34 oz. in. • Oper. Temp. Range, −55° to 150° C • Weight, 2.8 oz.

MOTOR: Motor Voltage (fixed & control phases), 26 • Power (Stall), 2.5 Watts

GENERATOR: Excitation, 26v, 400 c.p.s. • Power (Stall), 1.5 Watts • Output at 0 RPM, 0.010 V.R.M.S. • Output Voltage, 250 Mv/1000 RPM • Signal to Null Ratio, 25/1 at 1000 RPM

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Dual-Frequency Oscillator Design

By LEONARD KLIENBERG, Research & Development Lab, Gulton Industries, Inc., Metuchen, N. J.

OSCILLATORS capable of oscillating at two different frequencies simultaneously provide outputs that are a linear addition of two sine waves. Frequency ratios of 20:1 have been obtained, and the two output frequencies need not be harmonically related.

Theory

Qualitative operation of the oscillators is relatively simple to understand, but quantitatively they are quite difficult. Synthesis of the circuit is much simpler than analysis.

The generalized dual-frequency oscillator configuration is shown in Fig. 1A. Neglecting effects of the active element, oscillator frequency is $Z_1 + Z_2 + Z_3 = 0$. The circuits in Fig. 1B and 1C are simultaneous dual-frequency oscillators.

The circuit shown in Fig. 2A is a conventional Hartley oscillator and that in Fig. 2B is a Colpitts oscillator. If capacitors and inductors were interchanged, the Hartley oscillator would become a Colpitts oscillator and the Colpitts oscillator would become a Hartley oscillator. Two networks capable of appearing capacitive at one frequency and inductive at another are shown in Fig. 3.

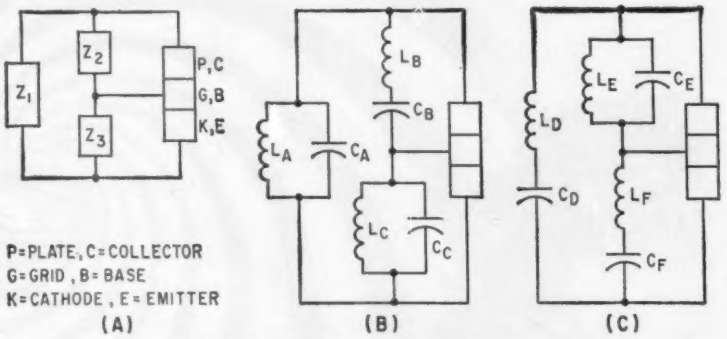


FIG. 1—Generalized dual-frequency oscillator is shown at (A). Lower of two frequencies is produced by Hartley oscillator at (B) and by Colpitts oscillator at (C)

Design

Assume two properly designed single-frequency oscillators, a Hartley and a Colpitts. Angular velocity ω_1 of the Hartley oscillator is less than angular velocity ω_2 of the Colpitts oscillator. A network configuration is required that appears as a Hartley oscillator at ω_1 and as a Colpitts oscillator at ω_2. These conditions are satisfied in Fig. 1B.

At ω_1, network L_AC_A appears as L_1; and at ω_2, it appears as C_2. Network L_BC_B appears as C_1 at ω_1 and L_3 at ω_2. Network L_CC_C appears as L_2 at ω_1 and as C_3 at ω_2.

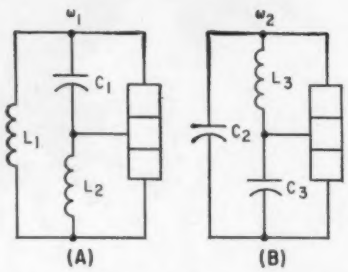


FIG. 2—Hartley oscillator (A) and Colpitts (B)

The equations for circuit values are:

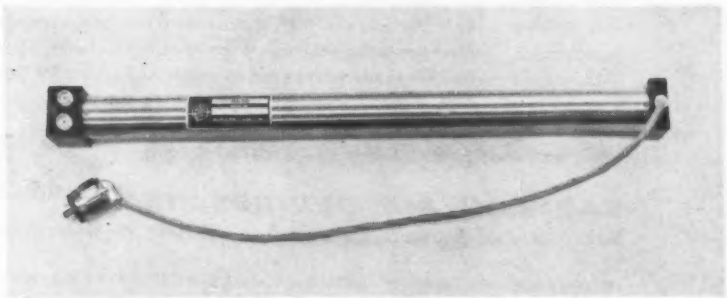
$$(-1/\omega_1 L_A) + \omega_1 C_A = -1/\omega_1 L_1 \text{ and}$$
$$(-1/\omega_2 L_A) + \omega_2 C_A = \omega_2 C_2;$$
$$\omega_1 L_B - (1/\omega_1 C_B) = -1/\omega_1 C_1 \text{ and}$$
$$\omega_2 L_B - (1/\omega_2 C_B) = \omega_2 L_3;$$
$$(-1/\omega_1 L_C) + \omega_1 C_C = -1/\omega_1 L_2 \text{ and}$$
$$(-1/\omega_2 L_C) + \omega_2 L_C = \omega_2 C_3.$$

The dual-frequency oscillator in Fig. 1C is for ω_1 greater than ω_2. The equations are:

$$\omega_1 L_D - (1/\omega_1 C_D) = \omega_1 L_1 \text{ and}$$
$$\omega_2 L_D - (1/\omega_2 C_D) = -1/\omega_2 C_2;$$
$$(-1/\omega_1 L_E) + \omega_1 C_E = \omega_1 C_1 \text{ and}$$
$$(-1/\omega_2 L_E) + \omega_2 C_E = -1/\omega_2 L_3;$$
$$\omega_1 L_F - (1/\omega_1 C_F) = \omega_1 L_2 \text{ and}$$
$$\omega_2 L_F - (1/\omega_2 C_F) = -1/\omega_2 C_3.$$

The number of frequencies at which an oscillator can oscillate

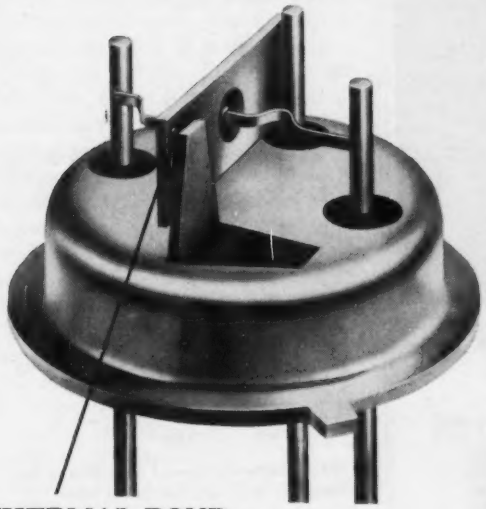
Electrostatically Focused TWT



One-watt twt is one of many developments to be shown at the 1960 International IRE convention. Developed by Huggins Laboratories, it operates over the range of 500 to 1,000 Mc with minimum small-signal gain of 28 db

5 GUARANTEES

for Tung-Sol 2N1313 Computer Transistor mean new freedom for designers



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And there's still another. For a nominal additional charge any specific electrical design characteristic will be 100% guaranteed not to exceed its distribution limits. These guarantees add up to a marked upgrade in circuit design accuracy . . . high reliability in operation . . . and consistent repeat performance. In specifying the Tung-Sol 2N1313 high speed switching transistor, you're selecting a transistor which features an ideal balance of the most wanted characteristics as revealed by a survey of computer designers. You're also choosing a transistor which offers improved performance at lower cost over most of today's popular computer types.

The 2N1313 is designed to meet vigorous military environmental standards. It features "Thermal Bond" construction, exclusive with Tung-Sol. The transistor junction tab is securely joined to the base of the transistor. The bonding material provides high heat dissipation while maintaining complete base-to-case electrical isolation.

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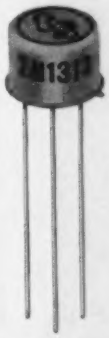
Absolute Maximum Ratings (@ 25°C)

BV_{CBO}.....–30 Volts
BV_{EBO}.....–20 Volts
BV_{CEX} (V_{BE}=0.1V).....–20 Volts
BV_{CEO}.....–15 Volts
I_C (continuous).....400mA
I_B (continuous).....50mA
T_j.....–65°C to+100°C
P_C.....180mW



Typical Characteristics (@ 25°C)

Parameter	Conditions	Min.	Design Center	Max.	Units
I_{CBO}	V_{CB} = –0.5V	—	1.5	2.5	μA
I_{CBO}	V_{CB} = –15V	—	2	3.5	μA
h_{FE}	I_B = 1mA, V_{CE} = –0.25V	40	70	125	
h_{FE}	V_{CE} = –0.35V, I_C = 400mA	20	30	50	
f α b	V_{cb} = –6V, I_c = 1mA	6	12	—	Mc
C_{OB}	V_{CB} = –6V, I_E = 1mA, f = 1Mc	9	14	20	μμf
(t_r + t_d) (rise plus delay time)	I_{B1} (turn on current to base) = 1mA; I_{B2} (turn off current) = 1mA; I_C = 10mA; R_L = 1K	—	0.45	0.70	μsec
t_s (storage)		—	0.30	0.60	μsec
t_f (fall)		—	0.25	0.40	μsec

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Ask for Bulletins B-07 and B-16

AIRPAX ELECTRONICS INCORPORATED

CAMBRIDGE DIVISION CAMBRIDGE, MARYLAND

simultaneously is not limited to two. Three single-frequency oscillators could also be combined to form a triple-frequency oscillator. It would combine a Hartley oscillator at ω_1, a Colpitts at ω_2 and a Hartley at ω_3. Three-element networks would appear as C_{11} at ω_1,

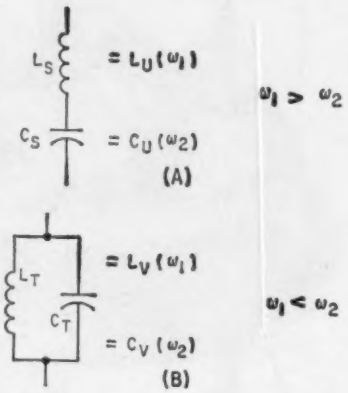
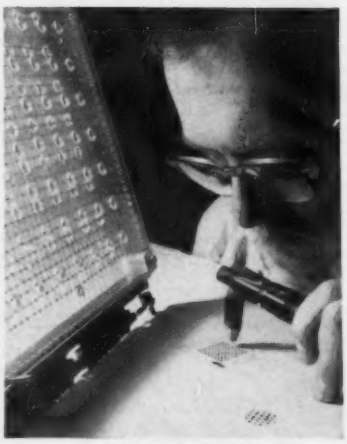


FIG. 3—Networks appear capacitive at one frequency and inductive at the other

L_{11} at ω_2 and C_{22} at ω_3; or L_{22} at ω_1, C_{33} at ω_2 and L_{33} at ω_3.

In the dual-frequency oscillator, adjustment or control of either of its operating frequency is difficult because the value of each component in the circuit is a function of the two frequencies.

Thin-Film Memories



Each of 64 magnetic thin film dots on 2-inch square glass contains one piece of information. Minneapolis-Honeywell scientists have placed as many as 1,024 dots on same size glass hoping to replace ferrite core memories like that shown at left

CIRCLE 183 ON READER SERVICE CARD 183

Race Car Crew Tests Biomedical Gear

BIOMEDICAL instrumentation system could telemeter physical and emotional reactions of spacemen back to earth. Norair division of Northrop is testing such a system on a racing car crew at speeds up to 170 mph. Jay Chamberlain, 1957 Le Mans road race winner, carried the astronautical instruments in a racing car to give the system its first test on a human under prolonged stress.

The system, developed in cooperation with Litton Industries, is being designed to give ground-based flight surgeons instant and continuous readings of physical and emotional condition of astronauts during space flights. Riding with Chamberlain, and also instrumented, was a Norair photographer. Instrumenting both men provided a comparison between reactions of a novice and those of a person accustomed to danger.

Electrodes on the men were connected to instruments that recorded pulse, breathing, heart and brain reactions. Galvanic skin resistance, one of the readings used in lie detector tests, was also used to indicate emotional changes.

Accelerometers measured forward and lateral acceleration of the car, and a photoelectric circuit recorded driveshaft rpm to give exact speed readings. Coordination of this information with the biomedical readings provided data on reactions at any speed or in emergencies such as skids (lateral acceleration).

Immediately after the track runs, the tape-recorded information was processed on data reduction equipment.

Supplementing the Litton bio-packs, which pick up and amplify body reactions, were Ampex airborne flight-test recorders. During space flights, only the bio-pack would be in the space vehicle. No air is miniaturizing it to fit in an underwear vest worn by an astronaut. Connected to the space vehicle power supply and telemetering system, it would transmit continuous readings to recording and monitoring equipment on the ground for immediate observation and later analysis.

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This remarkably compact transistorized power supply provides a highly regulated continuously variable output for all battery voltage ranges. Despite its low cost, it has a number of outstanding features which result in rugged performance and convenience of operation.

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Additional features include low power consumption, light weight and accessible location of all components.

SPECIFICATIONS:

Model Designation	TR436M
Output Voltage	4-36 VDC (divided into 4 ranges)
Output Current	0-500 milliamperes
Line Regulation	Less than 0.15% or 15 millivolts change for 105-125 VAC input, 60-400 cps
Load Regulation	Less than 0.05% or 15 millivolts change, no load to full load
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CIRCLE 185 ON READER SERVICE CARD 185

International IRE

New damping material, developed to reduce structural response to white noise, is examined by R. C. Henshaw, Lord's manager of operations, after evaluation test. Panel is constructed of a special broad-temperature-range elastomer sandwiched between metal sheets, and bonded to them. These structures are available in sections or laminated panels which may be added to existing hardware

Internally-damped cantilever beam (right) and conventional aluminum beam (left) tuned to the same frequency are examined by J. Ruzicka, development engineer, and E. Pietz, President of Barry. Their damped beams utilize viscoelastic materials sandwiched between metal plates. These techniques, which now help solve missile vibration problems, will be explained at the coming IRE show

How Built-In Damping Stills Vibration

By MICHAEL F. TOMAINO, Associate Editor

. . . as quiet you shall be
as halcyons brooding on a
winter's sea.
Dryden

An ancient legend tells of a mythical bird, called the halcyon, that could calm the violent motion of the waves when floating on the stormy waters during nesting time

ONE OF THE MOST vexing problems of space-age electronics is the search for a modern halcyon that can control the violent wave motions imposed on sensitive electronics by destructive vibration and jostling caused by high frequency accelerations transmitted to critical components.

Without proper resonant vibration control, it would be senseless to go on designing delicate electronic components only to have them shattered into disuse.

Last week some of the most knowledgeable vibration specialists in this country were kept busy explaining salient facts about materials and fabrication methods that may answer some of the most difficult problems connected with missile-borne gear: How to incorporate sensitive electronics into dynamic systems so as to drastically reduce resonant vibrations throughout the frequency range encountered under the most severe environments.

And during the next few weeks engineers will hear a lot about built-in damping.

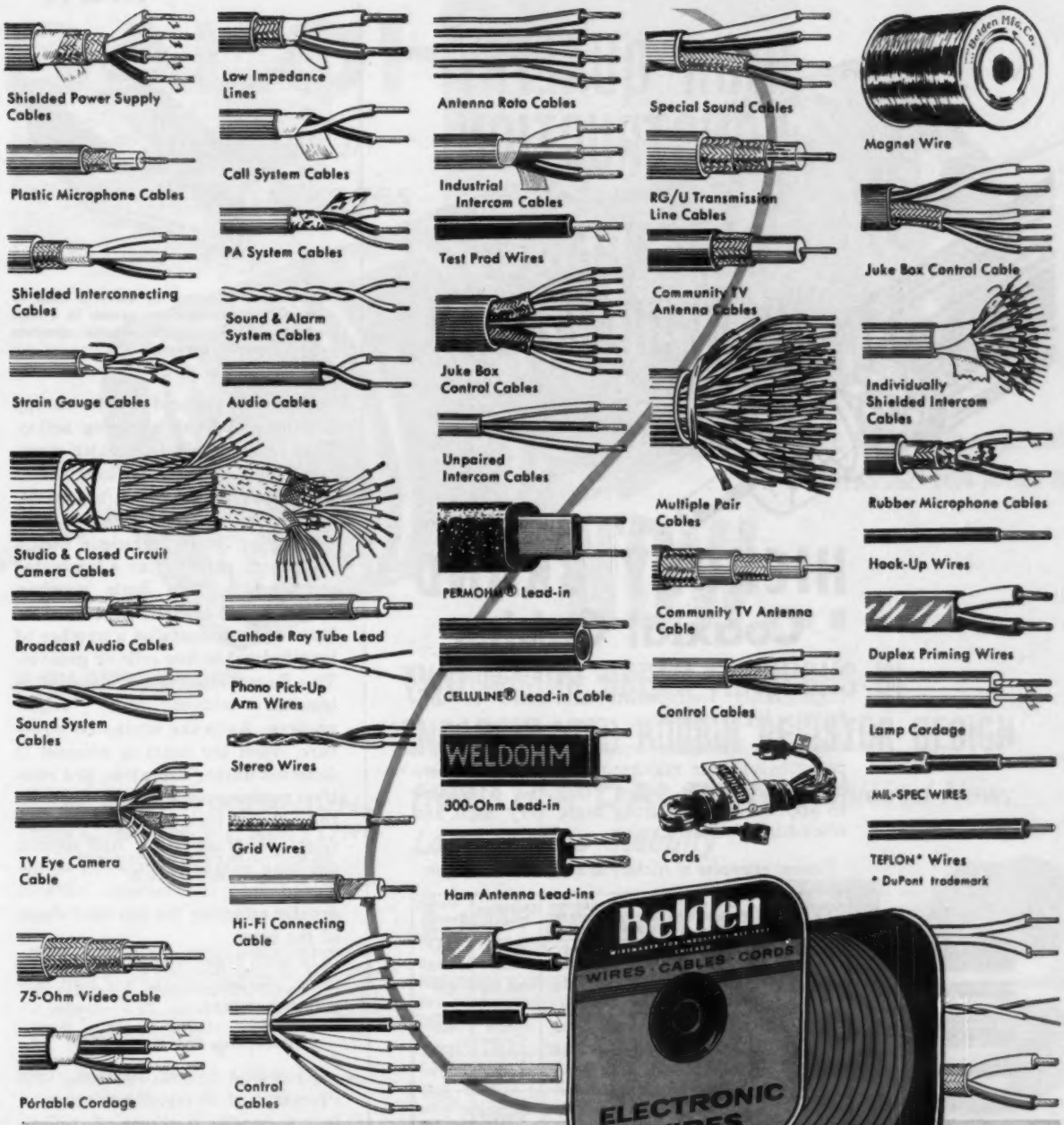
Materials and Design

While approaches used to avoid detrimental resonance conditions have been studied for years, recent developments by two vibration equipment manufacturers are showing electronics men how to design vibration-resistant structural members with high-damping characteristics that are built right into the hardware itself.

Vibration specialists at Barry Controls, Inc., of Watertown, Mass. are attacking detrimental resonance by incorporating high energy dissipation mechanism right into the load-carrying structure. And vibration specialists of Lord Manufacturing Co., Erie, Pa., are offering their own solution: a new noise and vibration damping material, with a built-in elastomer, that may have important implications for the aircraft and missile industry.

In the past there have been many approaches used to attack resonance: vibration isolators; rigidization of structural members; decoupling resonating systems; detuning coupled resonators; or using high fatigue-strength materials. But because of the complex nature of many unique stresses, these approaches cannot solve many modern problems of structural resonance.

One of the Barry techniques incorporates structures fabricated with a special viscoelastic damping medium sandwiched between laminates. Under flexural vibrations, the laminates slide relative to one another and produce a shearing of the viscoelastic medium. Resonant



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RG-9B/U	.280"	50	6.1	21.8	Double Copper	.420
RG-11A/U	.285"	75	5.2	18.5	Single Copper	.405
RG-13A/U	.280"	75	5.7		Double Copper	.420
RG-17A/U	.680"	52	2.8	11	Single Copper	.870
RG-59A/U	.146"	75	9	30	Single Copper	.242
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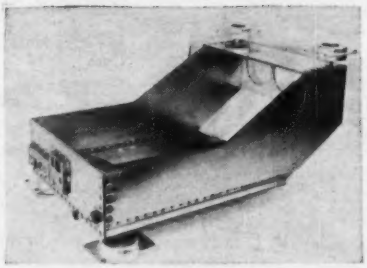

This damped structure by Barry is used to support a countermeasures system in a high performance aircraft. Honeycomb structure provides needed strength

response is reduced by the energy dissipated by this shearing action. These will be called RIGIDAMP structures. But Barry is out to sell their know-how rather than the materials alone.

Another Barry technique uses a cell-insert, rather than a laminated construction. The basic member, whether it be chassis, framework or base support, contains a number of longitudinal hollow cells or grooves. The Barry viscoelastic material is inserted within these hollow grooves. As in the laminated structure, when the beam or channel is deflected during vibration, the relative motion, or slippage, between the cell and insert, creates a viscoelastic shearing effect. And specific damping characteristics can be designed into the member without greatly affecting the physical shape of the beam.

In both types of Barry constructions, the laminations are load carrying members.

Including the Know-How

According to Ed Johnson, Vice President of Barry, their company is not in the business of selling viscoelastic materials, nor are they planning to compete with aluminum people on materials. But they are definitely interested in taking their know-how, gained in the area of built-in damping and applying this to solve specific problems in electronics.

According to R. P. Thorn, who is supervisor of electronic mounting applications at Lord, their built-in damping techniques employ an elastomer (rather than a viscoelastic material) that is physically bonded to the metal. This elastomer has tensile strength of the same

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- TEMPERATURE COEFFICIENT: .00002 per degree C.
- OPERATING TEMPERATURE:
  Type WW -55° C. to 125° C.
  Type HW -55° C. to 145° C.
- WIDE SIZE RANGE: Sub-miniature, 5/16" x 5/64" up to MIL size 2⅛" x ⅞"

REQUEST BULLETIN R-26D

1 NEW TERMINATION*

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TERMINAL DISC is welded to lead and firmly bonded to end of bobbin. Termination of last pi winding can be made at any point on periphery of TERMINAL DISC, allowing more accurate calibrating. This large TERMINAL DISC provides more welding area, thus insuring dependable welds.

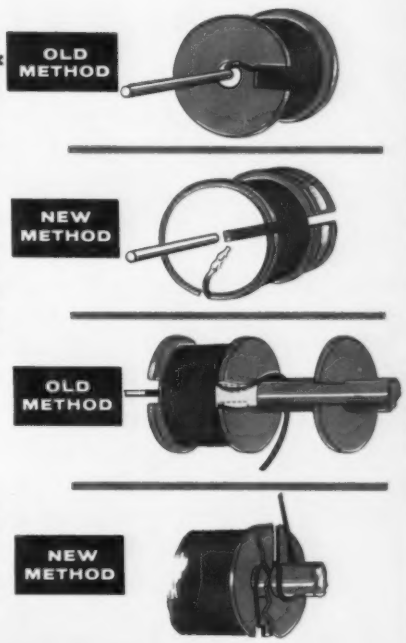
*(patent applied for)

2 NEW WINDING METHOD*

New TWIN-DISC winding separators remove need for insulating tape to prevent shorting between pi's.

TWIN-DISC separators make shorting physically impossible.

*(patent applied for)



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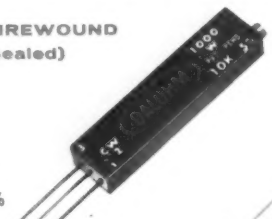
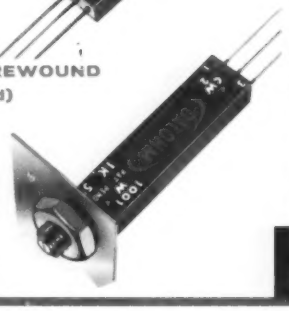


Rated at 2.5 watts
Resistance Range 10 ohms to 50K ohms
Standard Tolerance 5%

TYPE 1001 WIREWOUND
(Panel Mounted)



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Resistance Range 10 ohms to 50K ohms
Standard Tolerance 5%

Some Models are smaller than MIL. Spec. sizes

These T-Pots are miniature precision trimmer potentiometers, resistant to stringent environmental conditions. They are ruggedly constructed with completely sealed cases. A wide selection of terminal configurations provide solutions for demanding miniaturization design problems.

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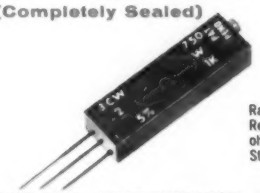
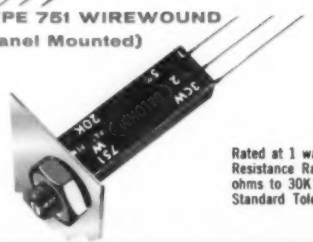


Rated at 2 watts
Resistance Range 10 ohms to 30K ohms
Standard Tolerance 5%

TYPE 751 WIREWOUND
(Panel Mounted)



Rated at 1 watt
Resistance Range 10 ohms to 30K ohms
Standard Tolerance 5%

DALOHM TYPE A10-W WIREWOUND

Ruggedly constructed miniature precision trimmer potentiometer. Fully reliable under severe environmental conditions. Four designs adaptable to demanding space requirements of precision circuits. Rated at 1 watt; Resistance Range from 10 ohms to 50K ohms; Standard Tolerance 5%.

DALOHM TYPE B11-W WIREWOUND

This miniature trimmer potentiometer is designed to give excellent performance, for normal circuit problems where economy is of prime importance, yet dependable performance is a necessity. It retains many of the advantages of the precision grade A10-W trimmer. Rated at 1 watt; Resistance Range from 10 ohms to 100K ohms; Standard Tolerance 10%.

DALOHM TYPE C12-W WIREWOUND

A low cost miniature commercial trimmer potentiometer that will give good performance for many applications where trimmer potentiometers are specified. It is reliable under environmental conditions found in most commercial and industrial equipment. Rated at ½ watt; Resistance Range from 10 ohms to 20K ohms; Standard Resistance 15%.

DALE PRODUCTS INC. 1300 28th Ave. Columbus, Nebraska

class as used in Lord's vibration isolators. Lord will supply this basic material, they will offer applications assistance, or will supply a completed system based on customer specifications. The Lord development, designated as DYNA-DAMP, employs a specialized form of Lord's BTR (broad temperature range) elastomer which maintains its damping and environmental resistance characteristics over the range from −65 to 250 F. This material is available in structural sections or laminated panels which may be added to existing structures.

Applications

The most obvious possible applications of both Barry's RIGIDAMP and Lord's DYNA-DAMP structures are electronic circuit boards, chassis, shelves, dust covers, aircraft parts, test fixtures, missile skins, relays and other parts.

Several actual production items have been built according to Barry's techniques. These include a mounting base for the stable platform in a production ground-to-air missile and mounting shelves for electronic equipment in a high performance Navy aircraft.

Prime military contractors of electronic gear, now responsible for defining fundamental problems in vibration for equipment they are now developing, are now drawing on the problem-solving abilities they can buy from organizations like Barry and Lord.

The specific basis for Barry's structural damping developments was explained by J. E. Ruzicka and R. D. Cavanaugh.[1,2] Description and technical data on Lord's sections and panels are included in a report written by R. P. Thorne and B. W. Campbell.[3]

Both of these developments will be exhibited and explained at the Institute of Radio Engineers Show, March 21-24 at the Coliseum, New York City.

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(2) J. E. Ruzicka, New Design Techniques for Damping Structural Resonances, 26 Jan '60 Barry Controls, Inc., Watertown, Mass.
(3) R. P. Thorn and B. W. Campbell, Damped Structural Sections and Three-Ply Laminates, Engineering Report 325, 1 Oct 1959 Lord Mfg. Co., Erie, Pa.

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Lumatron electronics

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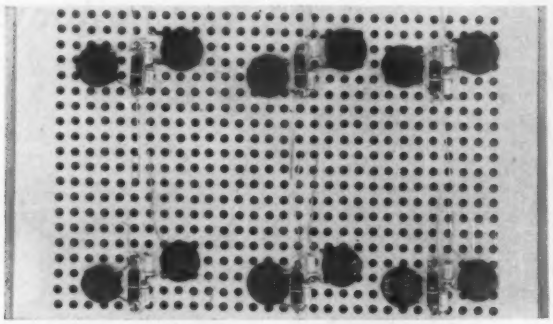
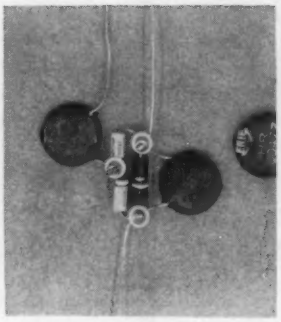
DALE PRODUCTS INC. 1000 20th Ave. Columbus, Nebraska
CIRCLE 281 ON READER SERVICE CARD

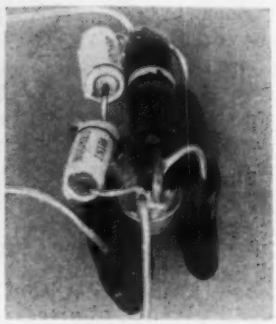
International IRE

Dip Solder on Pallet



Eyelet-assembled modules lift off pallet after dip-soldering





Bottom view of assembly (left) and unit folded for encapsulation

MODULE CONSTRUCTION method which borrows the assembly advantages of printed circuits—without using printed circuits—will be among the production techniques discussed at the IRE National Convention next week.

As reported by Leon Jacobson, of General Electric Company's Heavy Military Electronics Dept., Syracuse, N. Y., constructing modules on a peg board type pallet enables connections to be dip-soldered. Assembly is in a single plane with simple tools. Modules can then be folded and encapsulated in molds or plastic shells.

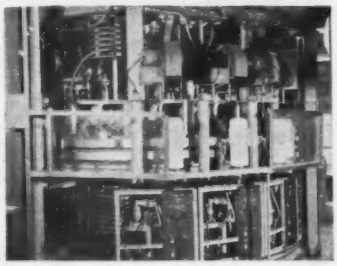
The photos illustrate how a typical module is made. The layout is drafted twice-size on a 0.4-inch grid. Connection points are at the intersections of grid lines. The layout is photographically reduced to the 0.2-inch grid of the pallet and may be optically projected on the pallet.

Undersized, tin-plated eyelets are placed in pallet holes at connection points. Leads are inserted in the eyelets. Flanges on the eyelets prevent them from falling through the pallet. After dip-soldering or flow-soldering, leads are trimmed and the assembly is lifted off the pallet. Dipping the web in a flexible plastic coating minimizes the possibility of shorting between bare leads.

Reliability is better than with hand-soldered modules, Jacobson says, because machine soldering gives closer control over process variables. Shop costs for hand-soldering compared with dip-soldering on the module illustrated showed

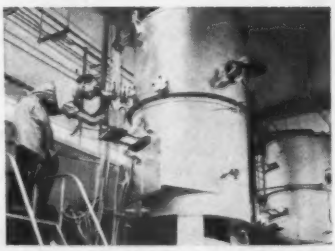
Machining copper parts

Handling over vapor degreaser



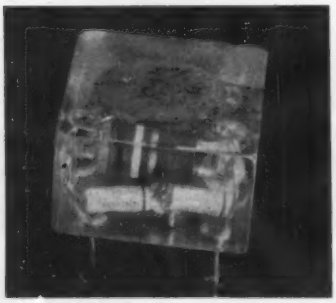
R-f rotary vacuum furnace

Metallizing ceramic cylinders



Vertical Ram hydrogen atmosphere furnace

Fixture for brazing ceramic



Encapsulated module is size of 3¢ stamp

after routing, clip and save

a continuing series on technical topics of specific interest to engineers

Folio 60-9 REFERENCE DATA FILE SANGAMO

capacitor characteristic designation

. . . . . and the story is told that Pelops was the son of Tantalus and the grandson of Jupiter. He was slain and served up before the gods by his own father, who wished to test the omniscience of the Olympians. They were not deceived, however, and would not touch the cannibal feast. But Demeter (Ceres), absorbed in grief for the loss of her daughter, Proserpina, tasted of the shoulder before she discoverd what it was. Jupiter restored Pelops to life, and replaced his shoulder with one of ivory, whence the ivory shoulder of the sons of Pelops became a proverbial phrase for the distinguishing or distinctive mark of anyone, since all the descendants of Pelops bore this characteristic. — Greek Mythology

The word "Characteristic" can mean many things in the description of capacitors. This article is aimed at removing some of the jargon associated with the term and clarifying its meaning and application to various capacitor types.

An indicator for "characteristic" is found in the nomenclature of many types of capacitors. It does not mean the same "distinguishing or distinctive mark" for all types. This is sometimes a source of confusion for equipment design engineers.

Typical examples of product nomenclatures including a "characteristic" identifier are:

1. SBA1H04104
2. CB11ND101K
3. SMDA1K04104K
4. CE34C101E
5. CM15E101K03

Items 1 and 3 are Sangamo nomenclatures for impregnated kraft tissue dielectric capacitors. Item 2 is a MIL type designation for a button style mica capacitor. Item 4 is a MIL type designation for an electrolytic capacitor. Item 5 is a MIL type designation for a plastic encased, axial wire lead mica capacitor.

The important information meant to be conveyed by the characteristic letter is shown below for Paper, Electrolytic and Mica capacitors.

PAPER CAPACITORS In the case of Sangamo products, this letter tells us:

1. The specific impregnant used in the dielectric. "H" is Sangwax, and "K" is Etherm. Detailed information on these impregnants is set forth in Sangamo Reference Data File—Folio 59-2.
2. High and low ambient test temperatures.
3. Minimum insulation resistance at 25°C., and at the high ambient test temperature.
4. Maximum capacitance change (in per cent of the initial value) from 25°C. to the low ambient test temperature.
5. Voltage (in per cent of rated) that can be applied to establish accelerated life performance capability.
6. Maximum and minimum allowable service operating temperatures consistent with normal life expectancy.

ELECTROLYTIC CAPACITORS The identifier letter spells out the working temperature range of the product as maximum and minimum values in degrees Centigrade. The inherent capability to perform is adjusted by:

a. Selection of insulating separators.
b. Formulation and control of the conductive electrolyte.
c. Selected processing techniques.

The performance parameters affected are:

I. At reduced temperature:
   a. DC leakage current.
   b. Capacitance change (in per cent of the initial room temperature value).
   c. Equivalent series resistance.
   d. Impedance.
II. At high temperature:
   a. Capacitance change (in per cent of the initial value).
   b. Equivalent series resistance.

MICA CAPACITORS The characteristic letter defines the capacitance stability of the unit during one "round trip" excursion from room temperature to minimum and maximum temperatures specified for the capacitor, although it does not specify the operating temperature range. It further defines the maximum temperature coefficient of capacitance. In the case of transmitting types, certain characteristic letters will also be associated with a required fifty per cent derating of radio-frequency current specified for that type.

The design factors affecting the "characteristic" performance of mica capacitors are:

a. The physical configuration (style) of the product. Button style capacitors are most stable in the family of mica dielectric units.
b. The relative nominal capacitance value in the design range. High capacitance values are inherently more stable than low values.
c. The electrode design. Styles using electrodes of deposited metal bonded to the dielectric plates (silvered) are more stable than styles using independent metallic foil electrodes.
d. Selection of mica quality.
e. Processing techniques.

It has been the purpose of this article to explore the meaning of the word "characteristic" as it applies to describing capacitor differences. While the term is used in a specific rather than a general sense, it serves its purpose to describe the "Ivory Shoulder" of the capacitor industry.

SC60-1

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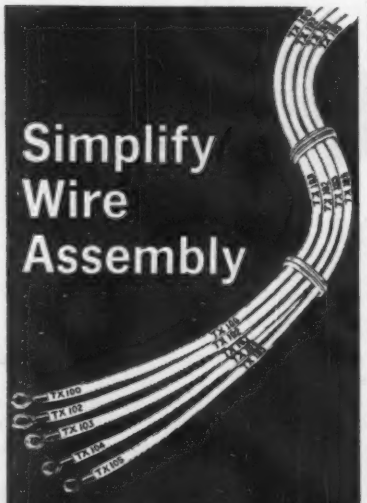

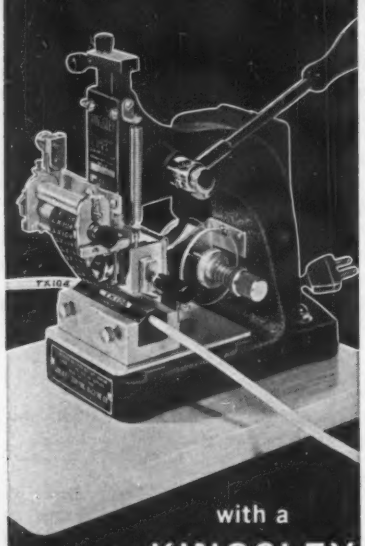

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a ratio of 4:1. The method is considered especially suited to small and medium-sized production runs.

Klystron Construction

James A. Jolly, of Eitel-McCullough, Inc., San Carlos, Calif., will outline methods developed to produce the X626, a super-power klystron over 10 feet tall. The huge size of the parts require novel handling techniques, some of which are illustrated.

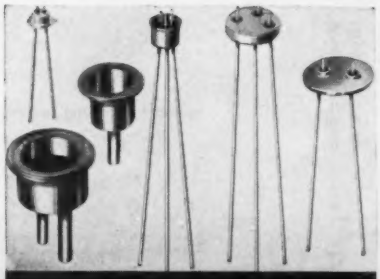
Metal parts, machined from copper billets, are outgassed in a rotary vacuum furnace with 12 vacuum systems and 3 r-f power sources of 15, 30 and 50 kw. As the vacuum systems rotate, they pass along bus bars that switch the r-f source to the individual bell jars, progressively reaching temperatures up to 1,400 C.

Ten-inch ceramic cylinders are metallized on the ends manually by a roller applicator which is continuously fed. The cylinders are fired in large ram furnaces. Gold-copper alloy is used to braze on the metal rings in large retort furnaces. The retort is sealed by welding and the furnace placed around the retort.

Outgassing the assembled tube requires a modular furnace. The tube is pumped out with 4 diffusion pumps joined by a large metal man-

Jig for surface grinding

Brazing fixture and anode assembly



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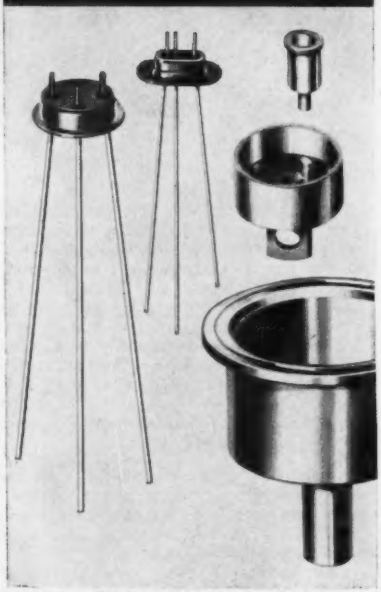

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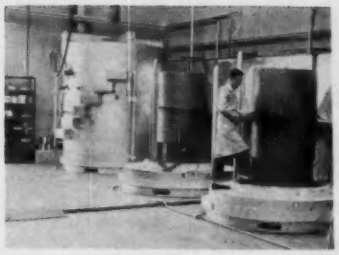

Retorts (front) and furnace

Assembling outgassing furnace around the tube

ifold. An inner nitrogen holder is placed around the tube to prevent oxidation during high-temperature bakeput. The furnace is then assembled around the tube. Outgassing takes 24 hours, during which temperatures and vacuum conditions are monitored by a movable control console.

Plastic Skin Protects Board-Mounted Relays

VACUUM-FORMED plastic skin is used as a protective coating by C. P. Clare & Co., Chicago, Ill., when it mounts unhoused relays on plug-in printed circuit boards. Sealed, mercury-wetted contact switches are placed inside the operating coils. Leads are soldered to the printed wiring and the board is roller or brush coated with a temperature-sensitive cement. The assembly is placed in a 300 F oven, with 5-mil vinyl or mylar-polyester film supported by a framework over the board. As the film softens, a vacuum drawn from the other side of the board bonds the film to the board in a conformal coating. The board is removed from the oven and small holes are punched in it to allow the procedure to be repeated on the other side. The skin is preferred to spray coating since it covers the space between the switch and coil. The packaging machine was made by Abbott Plastic Machines Co., Chicago, Ill.

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A specialized design of the Osborne Ratioformer is now in use in one of the major Missile programs.

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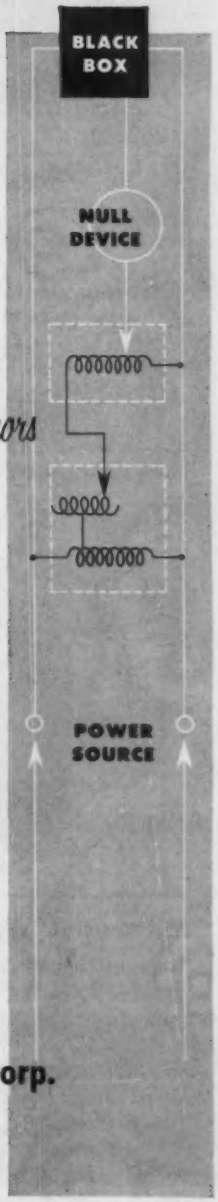
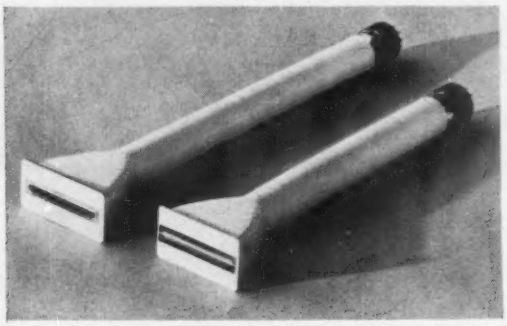


International IRE

ON THE MARKET *at the IRE Show*



Cathode Ray Tube, direct printing

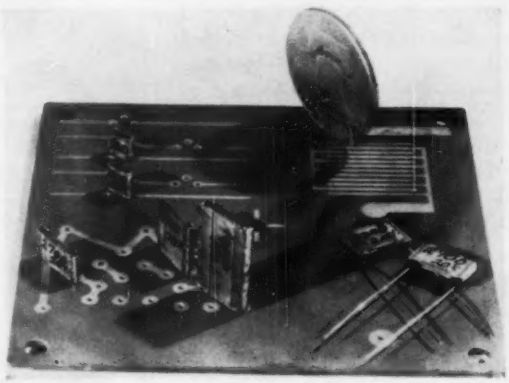
LITTON INDUSTRIES, 960 Industrial Road, San Carlos, Calif. Printapix crt for direct electronic printing at high speed on nonsensitized dielectric material. Type L-4013 provides a printing or writing head 0.15 in. high to accommodate writing of complete characters across entire head width. Head may also be used for sequential scan line (tv type) operation. Use of this tube type minimizes system requirements for operation. The L-4016 has a unidimensional conductive element array for sequential scan line operation.

CIRCLE 351 ON READER SERVICE CARD

Wafer Capacitors, with wire leads

CORNING ELECTRONIC COMPONENTS, Bradford, Pa., announces that high temperature solder wire leads are now available on all five sizes of its glass-dielectric wafer capacitors. The miniature capacitors now come with wire leads in a capacitance range of 1 to 10,000 $\mu\mu$f—10 times as great as before. Company says its purpose is to help designers fight the high price of real estate on printed circuit boards. The largest size, the WL-1, requires only 0.061 sq in. on a board and weighs only 2.5 grams. Capacitance range of the WL-1 is 4,301 to 10,000 $\mu\mu$f.

CIRCLE 352 ON READER SERVICE CARD



L-Band Oscillator, voltage-tunable

GENERAL ELECTRIC CO., Schenectady 5, N. Y., announces a new L-band electronically-tunable oscillator of interest to designers of radar countermeasure, telemetry, fusing and other communications systems. The Z-5405 can be electronically tuned over the 1,000 to 2,300 Mc frequency range with a minimum power output of 1w. Nominal or average efficiency over this range is approximately 20 percent while power variation is less than 1.5:1. Characteristics are: essentially linear voltage-frequency tuning; flat power response; high efficiency; and small size.

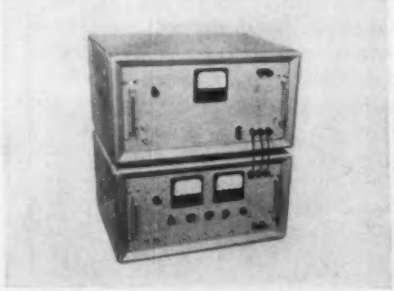
CIRCLE 353 ON READER SERVICE CARD

Microwave Wattmeter, highly accurate

WESTON INSTRUMENTS DIVISION, Daystrom, Inc., 614 Frelinghuysen Ave., Newark 12, N. J. This precision laboratory instrument comprises two basic units—a self-balancing bolometer bridge, model 1493, and a reference-current generator, model 1494. Required external accessories include a bolometer in a mount, a source of microwave power, and the means for making accurate measurements of direct current up to 30 ma. The bolometer bridge can measure power from the highest value for which the connected external bolometer is suited, down to about half that.

(Continued on p 198)

CIRCLE 354 ON READER SERVICE CARD



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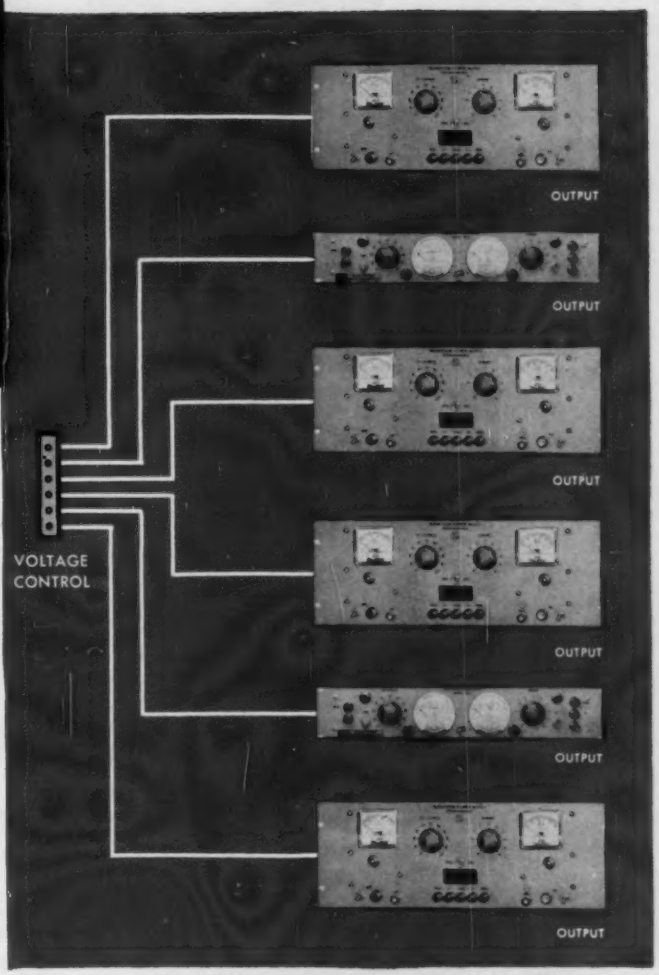

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For more information about the features of Regatron Programmable Power Supplies, ask for a copy of Bulletin 765D . . . A New Approach to Practical Control.

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			LINE 105—125 V AC 50—60 CPS		NO LOAD TO FULL LOAD		
	Voltage	Current	%	V	%	V	
212A[1]	0—100 V DC	0—100 MA	0.15	0.05	0.1	0.05	½
2-212A[1]	EQUIVALENT TO TWO MODEL 212A's. OUTPUTS MAY BE USED IN SERIES, PARALLEL, OR INDEPENDENTLY.						
224A[1]	0—100 V DC	0—200 MA	0.15	0.05	0.1	0.05	1
220A	0—50 V DC	0—500 MA	0.1	0.05	0.1	0.05	1
221A	0—100 V DC	0—500 MA	0.1	0.05	0.1	0.05	1
213A	0—50 V DC	0—1 AMP	0.1	0.05	0.1	0.05	1
214A	0—100 V DC	0—1 AMP	0.1	0.05	0.1	0.05	1
215A	0—50 V DC	0—3 AMP	0.1	0.05	0.1	0.05	1
218A	0—100 V DC	0—3 AMP	0.1	0.05	0.1	0.05	1

1. Modulation input provided for measurement of transistor parameters by small signal method.

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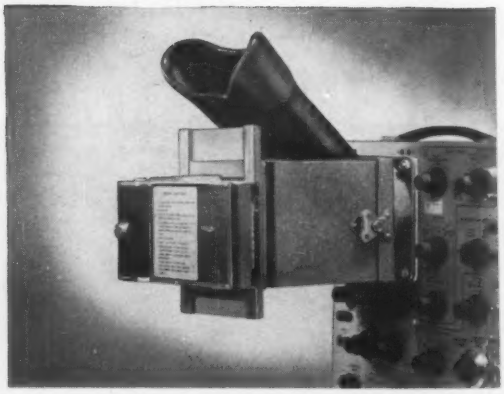


Oscilloscope Camera, vastly simplified

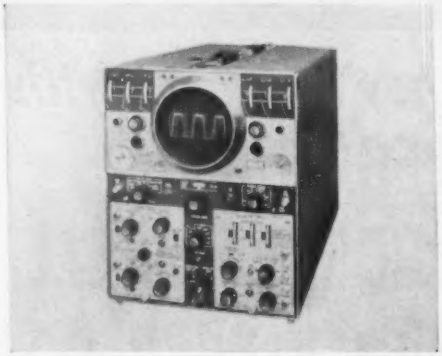
BEATTIE-COLEMAN, INC., 1050 N. Olive St., Anaheim, Calif. New oscilloscope recording camera, the Minute Man Oscillotron, features a Polaroid Land back providing either 60 sec prints or transparencies. Attaches to any 5-in. scope. Swings out, lifts off for easy accessibility. Light and compact, it is a precision instrument built for continuous duty. Wollensak 75 mm. f/2.8, f/1.9 standard or f/1.9 flat-field lenses are interchangeable. Of modular design, it can instantly be converted to record a wide range of object-to-image ratios. It can be removed from oscilloscope for other instrumentation photography. Price is $250.

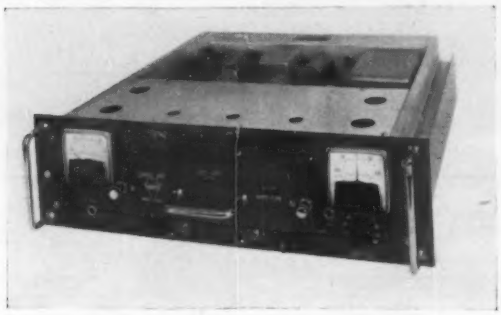
CIRCLE 355 ON READER SERVICE CARD

H-F Oscilloscope, digital readout

ALLEN B. DUMONT LABORATORIES, INC., 750 Bloomfield Ave., Clifton, N. J. Model 425 h-f oscilloscope features direct digital readout. It includes modular construction, a series of interchangeable plug-in amplifiers, and a new crt. Unit is useful over a frequency range from d-c to 60 Mc (down 3 db at 35 Mc). Digital readout system makes for laboratory accuracy, production, quality control and other manufacturing operations where the scope may now be used by the worker without any technical training. Scope provides two plug-in facilities. The interchangeable amplifiers for X functions include delaying sweep, dual-trace capabilities, and X-amplification. The Y plug-ins presently range from a 50 mv/cm, 33 Mc amplifier to a 500 μv/cm, 3-5 Mc unit of high stability.

CIRCLE 356 ON READER SERVICE CARD





Discriminator, for f-m telemetry

THE GEOTECHNICAL CORP., 3401 Shiloh Road, Garland, Texas. Dependable low-level data retrieval, no carrier threshold-crossing transients, and very high power output are features of model 4610 f-m subcarrier discriminator. No input attenuator is required. Input range is from 3 v down to 5 mv rms. Input impedance is over 1 megohm, shunted by 20 $\mu\mu$f. Protection of recorders from loss of carrier is not required. No violent transients are produced and recorder goes smoothly to zero when carrier is lost or fades in and out of noise. Linearities of $\pm$ 0.25 percent and $\pm$ 0.5 percent are standard. Output impedance is zero $\pm$ 10 ohms, adjustable. Power output from the operational amplifier is up to $\pm$ 100 v at 30 ma into 3,300 ohms.

CIRCLE 357 ON READER SERVICE CARD

D-C Drive Choppers, spdt and dpdt

STEVENS-ARNOLD, INC., 7 Elkins St., S. Boston 27, Mass., introduces a complete line of d-c drive choppers, both spdt and dpdt, featuring low noise and a 94-cycle chopping rate. In portable equipment these new choppers make it possible to build high performance circuits designed around a chopper with a noise level specification of 1 μv into 100,000 ohms. In the nonportable field, the substitution of a d-c drive for the

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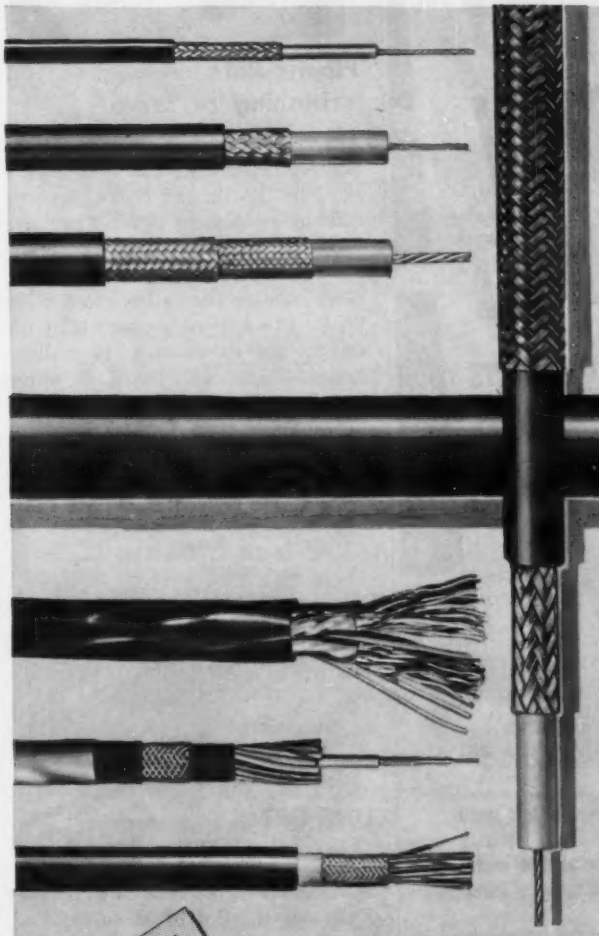
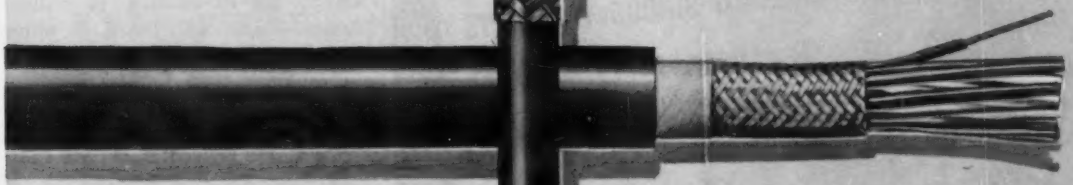


RG TYPE COAXIAL CABLES

Chester RG Type Coaxial Cables are made in both military and non-military versions, single or multi-conductor. Miniature designs are available in a choice of foam and solid polyethylene or in Teflon insulations, and in variations which include double shielding with polyethylene separator and jacket for TV systems or other low loss, all weather, signal transmission applications. Military types meet MIL-C-17 and all other applicable government specifications.



MULTI-CONDUCTOR CABLES

Chester is the recognized leader in the manufacture of multiple-conductor cables for computers and related electronic equipment. These cables can be supplied to *your* design –ranging in size from miniature to large diameters, shielded or unshielded, in a wide selection of thermoplastic insulating and jacketing materials. Any combination of appliance wire, hook-up wire and military approved wires, as well as coaxial cables and shielded conductors can be grouped to meet your specific needs. Send us your requirements for prompt engineering cooperation and price quotation.

Complete data on Chester's full line of wires and cables for military and commercial electronic service available on request. Ask for Bulletin No. ELT-1.

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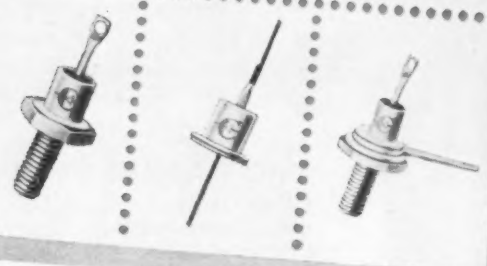

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conventional a-c drive means that the a-c drive wiring is removed from the critical circuitry. The power supplies used with transistorized circuits are well suited to supply the 12 or 24 v d-c required to drive the chopper.

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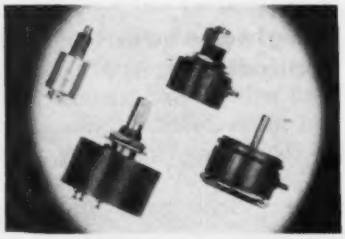

Plastic Pots
bushing or servo

ACE ELECTRONICS ASSOCIATES, INC., Somerville, Mass., has available ½ in., ⅜ in., 1⅛ in. and 1⅝ in. Acemho conductive plastic pots. They are available in a full range of resistances, from 250 ohms to 150 K ohms, and power ratings to 3 w at 65 C. Resolution is essentially infinite; life expectancy, 10 million cycles; noise, well below 25 ohms at 1 K; independent linearity, ±0.5 percent standard, lower on special order. All sizes meet applicable MIL specs for environment.

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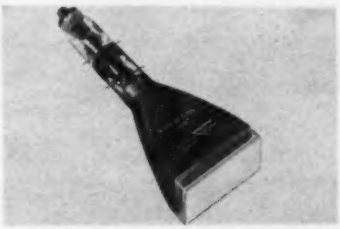

UHF CRT
less than 9 in. long

WATERMAN PRODUCTS CO., 2445 Emerald St., Philadelphia 25, Pa. The Rayonic type 3ATP1 crt is designed for frequencies in the 100 Mc range at altitudes up to 90,000 ft without the disadvantages of potted bases or special containers. The second anode and all deflection plates are brought out through the bulb to reduce input capacitance and allow high voltage operation. A 1½ in. by 3 in. flat face allows

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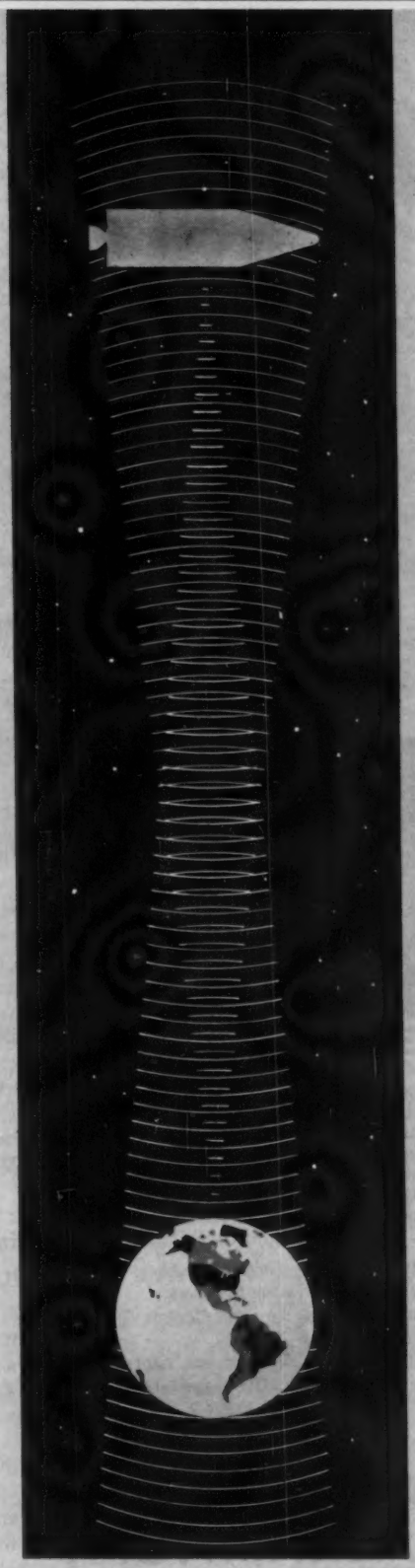
ELECTROMAGNETICS



Lockheed Missiles and Space Division maintains extensive research capabilities for the development of antennas and electromagnetic devices for space vehicle applications.

Laboratory studies in antennas and electromagnetic propagation include the application of solid state materials to microwave transmission line component and parametric circuits; the design of antennas to survive the rigors of space flight; and the effects of scattering from missile and space vehicle structures.

Research is also being conducted in the application of MASERS; on problems of radio transmission between space vehicles and Earth; effects of reentry ionization on radio transmission and reception; and development of antennas for data link systems between satellites and ground stations.

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Lockheed Missiles and Space Division has complete capability in more than 40 areas of science and technology – from concept to operation. Its programs reach far into the future and deal with unknown and challenging environments. If you are experienced in electromagnetics or in related work, we invite you to share in the future of a company with an outstanding record of achievement and make an important individual contribution to your country's scientific progress.
Write: Research and Development Staff, Dept. C-22, 962 W. El Camino Real, Sunnyvale, California.
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Input Capacity:	Under .01 $\mu\mu$ fd
Input Impedance:	Over 10^{17} ohms
Output Impedance:	Less than 0.2 ohms
Accuracy:	To .001%
Sensitivity:	To 60 electron/second (10^{-18} amperes)

Size: 10" x 7" x 4"
Weight: 9 lbs.

Write for complete data, specifications and application information.

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undistorted waveforms to be viewed with a sensitivity of 33 v/in. vertical at 2,000 v anode potential. Tube features high light output with small spot size.

CIRCLE 360 ON READER SERVICE CARD

Insulation Tester nondestructive

ARIZONA INSTRUMENT CORP., 3839 N. 39th Ave., Phoenix, Ariz. Model AI-5E is a combination hi-pot and insulation tester. It tests electrical products at the high voltages necessary to detect insulation weaknesses, shorts, or grounds, and will indicate the presence of faults without destroying the item under test. Fail-safe circuit automatically removes the test voltage when the predetermined leakage current level is exceeded, providing maximum operator safety, eliminating the need for expensive safety cabinets, and saving inspection time, production time and costs. Voltage range: 0-3,500 v d-c and 0-2,500 v a-c at 60 cps. Insulation resistance range (megohms at 500 v d-c) in three scales from 3.5 to 50,000.

CIRCLE 361 ON READER SERVICE CARD

Precision Switch hermetically sealed

TEXAS INSTRUMENTS INC., Metals & Controls Division, 34 Forest St., Attleboro, Mass. The Klixon AT1-1 hermetically sealed precision switch weighs less than 1/28th of an ounce. Size reduction is made possible by the use of a snap-acting, "W-blade" element. Envelope dimensions are 0.320 in. diameter by 0.440 in. long. Current capacity is 3 amperes, 28 v d-c, resistive; ambient temperature range, — 65 F to +275 F; contact arrangement, spdt; 10,000 cycle life minimum; resistance to 40 g's vibration and 100 g's shock; overtravel, 0.003 in. minimum; movement differential, approximately 0.002 in.; pretravel,

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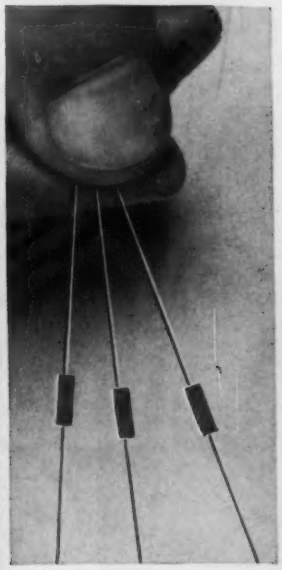
CIRCLE 339 ON READER SERVICE CARD

Hi-Q CERAFIL CAPACITORS



wherever size must come DOWN

and performance must go UP...

Combining extreme miniaturization with proven high reliability CERAFIL capacitors offer the ideal answer to design engineers faced with critical space and weight problems in airborne and spaceborne equipments and in transistorized circuitry requirements where space is at an absolute premium.

Exclusive new design and construction features of CERAFIL capacitors make it possible to obtain extremely high capacities per unit volume. They are positively the smallest ceramic capacitors available anywhere.

Available in capacities from 10 mmf to 100,000 mmf, Type C80 CERAFIL capacitor is rated at 100 VDC at 85°C and derated to 50 VDC at 125°C. They will meet or exceed all the applicable requirements of MIL-C-11015B.

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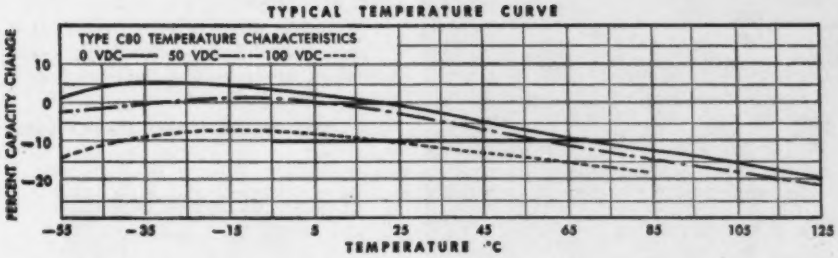
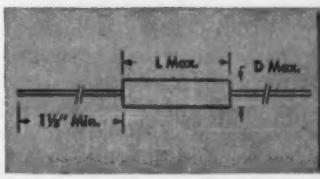
TYPICAL TEMPERATURE CURVE



ELECTRICAL SPECIFICATIONS

Working Voltage DC	Test Voltage DC (Flash)	Capacitance Change Over Temperature Range of −55°C to +85°C	Capacity Tol. (%)
100	300	+10% −15% with no voltage applied +10% −35% with 100 volts applied	±20 +50 −20 GMV
Power Factor: 2.5% Max. Insulation Resistance: 100 mfd.—megohms or 10,000 megohms whichever is smaller.			



CAPACITY (MFD)	C80—DIMENSIONS DIA.	LENGTH
10 mmfd. thru .001 mfd.	.090	.320
.005	.120	.500
.01	.180	.500
.02	.200	.550
.05	.240	.650
.1	.310	.750

Hi-Q® DIVISION

AEROVOX CORPORATION

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CIRCLE 203 ON READER SERVICE CARD 203

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0.005 in. Actuating force is 12 oz ±8 oz and release force, 1 oz minimum.

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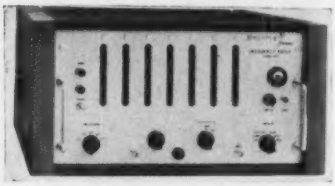
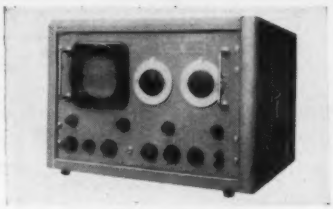


Frequency Meter digital type

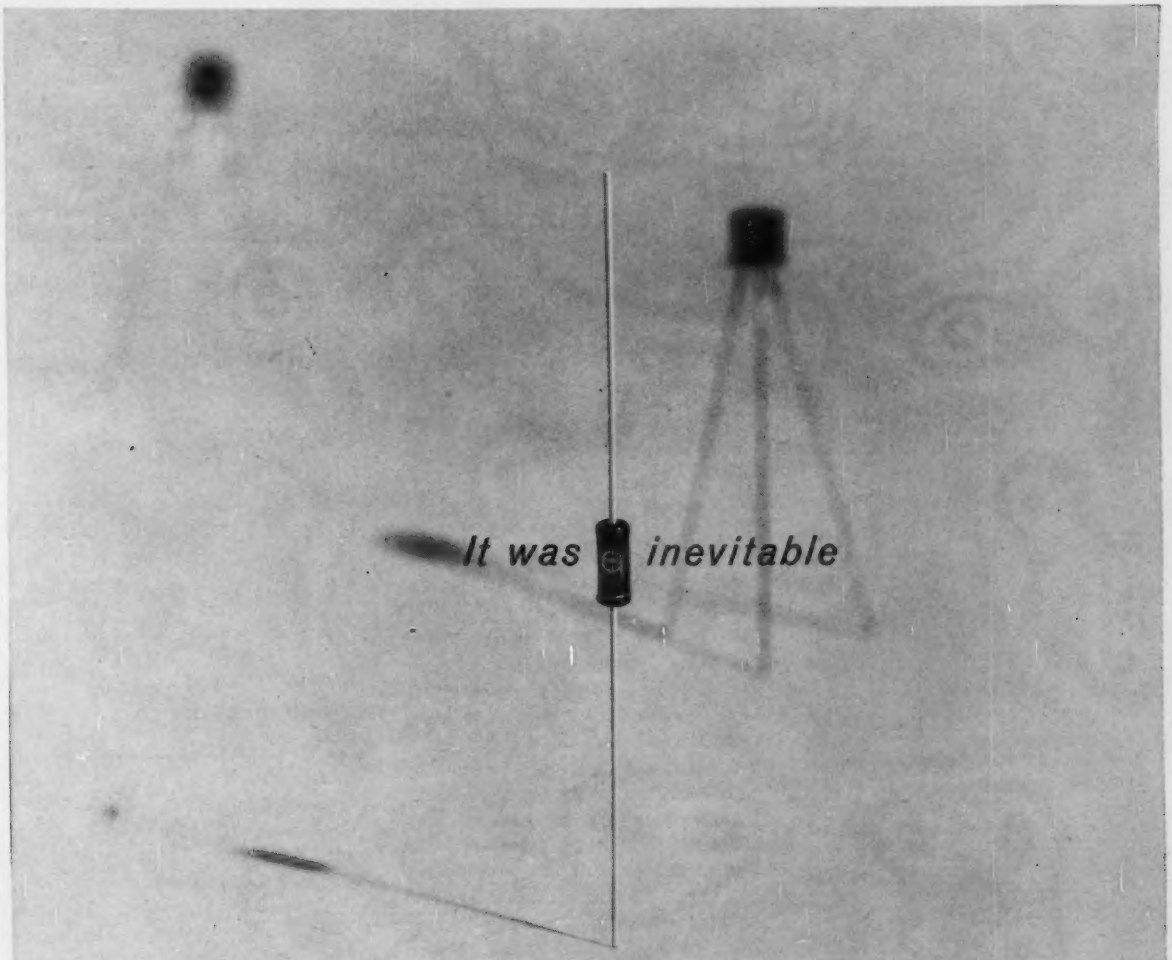
BERKELEY DIVISION, Beckman Instruments, Inc., 2200 Wright Ave., Richmond, Calif. Model 7175 digital frequency meter, occupying only 8¾ in. of rack space, measures any frequency from 10 cps to 110 Mc. Accuracy is 0.00003 percent ±0.1 cps. Sensitivity is 100 mv rms. Input impedance is 1 megohm up to 10 Mc, 100 ohms above 10 Mc. Meter consists of a 10 Mc counter closely integrated with a heterodyne frequency converter. Measurements are made by selecting a reference frequency with one switch, then reading the digital display.

CIRCLE 363 ON READER SERVICE CARD



Spectrum Analyzer 7 cps to 23 Kc

PROBESCOPE CO., INC., 8 Sagamore Hill Dr., Port Washington, N. Y., Model SS-20 will give a high resolution Fourier analysis in the 7 cps to 23 Kc spectrum. It is designed for use with vibration systems, sonic noise and whistle analysis, tape recorder testing and magnetic tape analysis. Specifications include a continuously variable sweep width from 50 cps to 6 Kc with automatic optimum resolution, 500 μv full scale sensitivity, 60 db dynamic range and a linear and log amplitude scale. A synchronous sweep generator, signal alternator,



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THE FIRST — An ultra-fast computer diode: Four millimicrosecond maximum reverse recovery time of this new FD 100 overcomes the diode-caused speed limitations in computer circuits. Capacitance is only 2$\mu\mu$f at zero volts bias.

THE REASON — A need and the technology to serve it: Fairchild's diffused silicon transistors have achieved heretofore unattainable performance. Application of these transistors has in turn created the need for silicon diodes of similarly outstanding performance.

THE FOLLOW UP — A broad line of high reliability diodes: This Fairchild FD 100 diode is being followed by others providing industry-leading standards in reliability and uniformity – backed by a continuing accumulation of statistical data on a large scale.

TENTATIVE SPECIFICATIONS — FAIRCHILD FD 100
25°C Except As Noted

Symbol	Characteristic	Min.	Max.	Conditions
BV	Breakdown Voltage	40 volts		@ I_R =100 μA
I_R	Reverse Current		.100 μA	@ V_R =30v, 25°C
V_F	Forward Voltage Drop		1 v	@ I_F =10 mA
C	Capacitance		2 $\mu\mu$f	@ V_R =0v
t_{rr}	Reverse Recovery Time To Ir=1 ma		4 mμs	@ I_f =I_r=10 ma
	Maximum Power Dissipation		200 mw.	
	Temp. Range Operating		−65°C to 175°C	
	Storage		−65°C to 200°C	

For full specifications, write Dept. A-3.
See us at Booth #2701-3-5-7 on the second floor at I.R.E.

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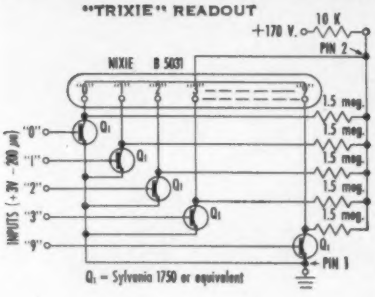
"TRIXIE" READOUT



A REVOLUTIONARY CIRCUIT DESIGN MAKES THE NIXIE® INDICATOR TUBES DIRECTLY COMPATIBLE WITH TRANSISTOR CIRCUITS

New "junction protection" technique permits the use of medium voltage NPN transistors to operate the Nixie indicator tubes.

The result is the lowest power, all-electronic visual readout.

"Trixie" readouts are immediately available from stock.

For complete information write today for Technical Bulletin #TR 56.

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variable rate generator and range extender are some of the special attachments available to increase the use of the spectrum analyzer.

CIRCLE 364 ON READER SERVICE CARD

Precision Pot
molded housing

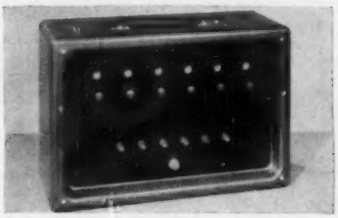
DEJUR-AMSCO CORP., 45-01 Northern Blvd., Long Island City 1, N. Y. The BC-200 ball bearing precision pot has a one-piece molded housing and complete phenolic envelope inside. Terminals are integrally molded into the housing for extra strength and increased clearance. This feature also prevents moisture from seeping into the terminals and creating a leakage problem. The 2-in. diameter unit is a single turn pot with improved linearity and lower starting and running torque. Ganging can be accomplished readily with special drive pin and tension pickup combinations supplied with each pot.

CIRCLE 365 ON READER SERVICE CARD

Power Supply
transistorized

ELECTRONIC RESEARCH ASSOCIATES, INC., 67 Factory Place, Cedar Grove, N. J., has available a compact power supply which provides highly regulated continuously variable output for all battery voltage ranges. Unit includes a vernier voltage control which permits fine adjustment of the output voltage. Outputs are isolated and either terminal may be grounded or units can be stacked for higher voltage operation. Thermostatic monitoring of the transistor base temperatures prevent thermal runaway and damage to the unit or external circuit. A unique current limiter circuit protects against transient overloads. Price is $135.

CIRCLE 366 ON READER SERVICE CARD



Comparator
high impedance

WAYNE KERR CORP., 1633 Race St., Philadelphia 3, Pa. Type B-921 is a three-terminal bridge to compare impedances of the order of megohms against a known standard. Accurate to 0.001 percent, it has a voltage ratio adjustable between 0.311:1 and 3:1. Frequency range is 400 cps to 10 Kc; input voltage is 30 v max.; input transformer, 60 h approximately at 50 cps; range of comparison, 0-3; and discrimination 1 in 10^5 (at ratios 1 to 3). Unit operates in the a-f band, and with an accuracy equal to the discrimination of 1 part in 10^5.

CIRCLE 367 ON READER SERVICE CARD

Laminates
sheets or strips

SYNTHANE CORP., Oaks, Pa. Grades ARF-HT and G3-HT laminated plastics can be used at temperatures up to 500 F. The ARF-HT is an asbestos mat plastic, and G3-HT is a glass fabric plastic; both have modified phenolic resin binders for high temperature resistance, and both come in sheets and strips or, for special requirements, in tubes. ARF-HT has flexural strength of 35,000 psi lengthwise, and 25,000 psi crosswise; 40 percent of the original flexural strength is retained after 1,000 hr

CIRCLE 207 ON READER SERVICE CARD→

not one life failure

In November of 1957, the first Ultra Long Life **NIXIE** Indicator Tube was developed and put on life test. In 1958, the first 100 production tubes joined this life test which subjected the tubes to the most severe conditions; i.e., constant "lighting" of one of its 10 numbers. To date, **not one life failure** has been experienced. This rigid test has been in progress in excess of 10,000 hours which is the equivalent of more than 50,000 hours of normal usage.

In applications from milling machines to computers to digital voltmeters, to counters, tens of thousands of Ultra Long Life **Nixie** Indicator Tubes have been operating over one year **without a single life replacement.**

- Lowest Cost — Check low quantity prices
- No replacement or Servicing Problems
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- Lightest Weight
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- Smallest Volume, Any Number Size
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- All Electronic
- Longest Life

Write today for eight page brochure featuring Burroughs Nixie Indicator Tubes

ANOTHER ELECTRONIC CONTRIBUTION BY

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ELECTRONIC TUBE DIVISION

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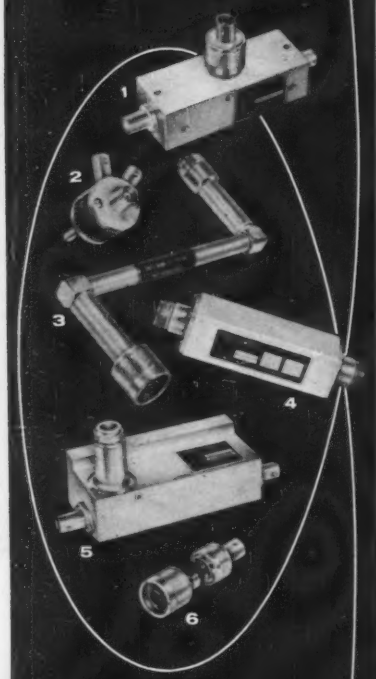
Automatic

designs and manufactures

Complete Coaxial Systems



1. 30db SAMPLER
2. SPDT SWITCH
3. LOW PASS FILTER
4. 5db ATTENUATOR
5. 10db DIRECTIONAL COUPLER
6. CRYSTAL DETECTOR

AND . . . CONNECTORS, OF COURSE!

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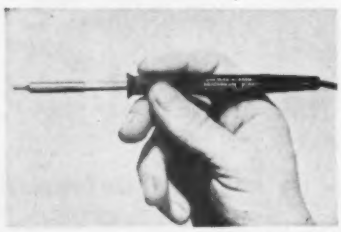
exposure to 500 F; and 90 percent of the compressive strength, which is 50,000 psi flatwise, is retained after 1,000 hr exposure to 500 F. G3-HT has flexural strength of 60,000 psi lengthwise, and 50,000 psi crosswise; 40 percent of the original flexural strength and 80 percent of the compressive strength, which is 50,000 psi flatwise, are retained after 1,000 hr exposure at 500 F.

CIRCLE 368 ON READER SERVICE CARD

VTVM
versatile unit

HEWLETT-PACKARD CO., 275 Page Mill Road, Palo Alto, Calif. Model 411A versatile vtvm has a frequency range of 5 Kc to 1,000 Mc. Voltage range is 1 mv to 10 v, with 10 mv full scale sensitivity. Accuracy is ±3 percent of full scale, 10 Kc to 50 Mc; ±6 percent of full scale, 50 Mc to 150,000 Mc; ±1 db 5 Kc to 1,000 Mc. The voltmeter has a large linear meter scale.

CIRCLE 369 ON READER SERVICE CARD



Soldering Iron
pencil-type

ORYX CO., 13804 Ventura Blvd., Sherman Oaks, Calif., has developed two new 115 v a-c soldering instruments. Weighing only 1 oz plus cord each, models 115-10 W

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240 Wythe Avenue
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CIRCLE 340 ON READER SERVICE CARD

GENERAL INSTRUMENT CORPORATION

PIV up to 600 V.

high conductivity

150 ma @ 150 C.

low leakage

400 ma 25 C.

AUTOMATIC SUBMINIATURE silicon power diode/rectifiers

designed to meet USAF MIL-E-1/1143 specs

These fine silicon diode/rectifiers meet and exceed the USAF specs . . . and retain their outstanding characteristics and reliability at temperatures of 150° C. and more! Complete technical information on these and other General Instrument semiconductors is available upon request.

JEDEC TYPE NO.	MAXIMUM RATINGS			ELECTRICAL CHARACTERISTICS			
	PEAK INV. VOLTAGE (V)	MAX. AVG. RECTIFIED CURRENT (mA)* @ 25° C.	MAX. AVG. RECTIFIED CURRENT (mA)* @ 150° C.	MINIMUM SATURATION VOLTAGE @ 100° C. (VOLTS)	MAXIMUM REVERSE CURRENT @ PIV (uA) @ 25° C.	MAXIMUM REVERSE CURRENT @ PIV (uA) @ 100° C.	MAXIMUM VOLTAGE DROP @ 400 ma DC @ 25° C. VOLTS DC
1N645	225	400	150	275	0.2	15	1.0
1N646	300	400	150	360	0.2	15	1.0
1N647	400	400	150	480	0.2	20	1.0
1N648	500	400	150	600	0.2	20	1.0
1N649	600	400	150	720	0.2	25	1.0

*Resistive or inductive load

GI

Semiconductor Division

GENERAL INSTRUMENT CORPORATION

65 Gouverneur Street, Newark 4, N. J.

Midwest office: 5249 West Diversey Ave., Chicago 39

Western office: 11982 Wilshire Blvd., Los Angeles 25

GENERAL INSTRUMENT CORPORATION INCLUDES: W. S. BICKLEY DIVISION, AUTOMATIC MANUFACTURING DIVISION, SEMICONDUCTOR DIVISION, RADIO RECEPTOR COMPANY, INC., THE HARRIS TRANSDUCER CORPORATION, MICAMOLD ELECTRONICS MANUFACTURING CORPORATION AND GENERAL INSTRUMENT — W. S. BICKLEY OF CANADA LTD., SUBSIDIARIES.

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Lapp

and 115-15 W are available for immediate plug-in without a step-down transformer. Model 115-10 W heats to 672 F in 70 sec. Standard tip is $\frac{3}{32}$ in., but $\frac{1}{16}$ in. replacement tip is available. Model 115-15 W with $\frac{3}{32}$ in. tip achieves 717 F in only 50 sec. It also accommodates $\frac{1}{16}$ in. and $\frac{1}{8}$ in. replacement tips. The interchangeable tips are chrome copper alloy with nickel plating for long life.

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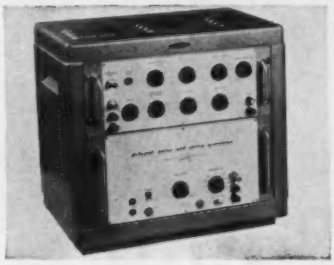

Pulse Generator
0.01 μsec rise

MARCONI INSTRUMENTS, 111 Cedar Lane, Englewood, N. J. Pulse generator model 3352 can be externally driven to 3 Mc pulse repetition rate (1.1 Mc internal) and will generate pulses as short at 0.09 μsec. Pulse repetition rate, delay from prepulse and pulse width are all independently controlled, and accurately calibrated. Maximum output is 50 v. Unit has excellent pulse shape which is free from overshoot or droop. There is no duty cycle limitation. Generator can be used for measuring the resolution of pulse circuits, and for measurements and studies in radar, telemetering, nucleonics etc.

CIRCLE 371 ON READER SERVICE CARD

Trimmer Pot
meets MIL specs

DALE PRODUCTS, INC., Columbus, Nebr. The 1200 series trimmer potentiometer meets requirements of MIL-R-27208 (USAF) style RTP11 and MIL-R-22097 (Navy) style RT11. The 25 turn T-pot features complete welded construction of all fixed connections, and sealed construction for maximum protection from severe environmental conditions. Rated at 1 w to 90 C, it has

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FOR THE COMBAT MARINE

Stromberg-Carlson-San Diego, in cooperation with the U.S. Marine Corps, has developed a revolutionary new tactical communications concept that will instantaneously transmit intelligence from forward observers and present a simultaneous tactical display to command. Known as BASIC (Battle Area Surveillance and Integrated Communications), it works this way:

Forward observers are equipped with small, hand-held digital message generators on which reports are "set up" through a series of switches. After checking the accuracy of his message, the observer sends the entire message in a short burst over his standard field communications equipment. The burst transmission doesn't interfere with simultaneous voice communication over the same radio channel.

Back at the command post, surveillance information is instantly displayed on a tactical map and simultaneously presented on typewritten cards showing target identity, location and other important information. Data may be fed directly to tactical computers for artillery fire control.

The same techniques and equipment used for the Marine Corps' BASIC concept are readily adaptable to a multitude of other military and commercial communications and display systems. For information about how BASIC techniques can solve your problems, contact Stromberg-Carlson-San Diego, Dept. A-31, 1895 Hancock Street, San Diego 12, California. Telephone CYpress 8-8331.

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A DIVISION OF **GENERAL DYNAMICS CORPORATION**

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McCoy

G-20 & G-21 MINIATURE

ALL-GLASS

HC-18/U TYPE

CRYSTAL UNITS

Possess all of the quality and dependability for which the McCoy line of metal encased crystal units is famous.

Check these advantages:

- Excellent Long-Term Stability
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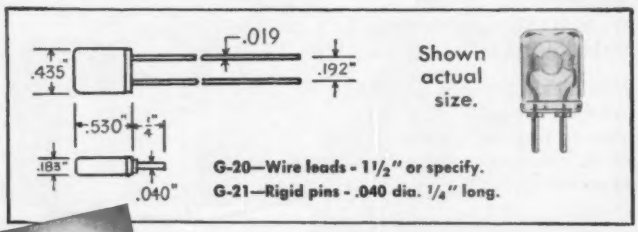


Shown actual size.

G-20—Wire leads - 1½" or specify.
G-21—Rigid pins - .040 dia. ¼" long.

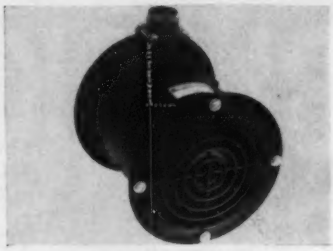
Write today for our free illustrated catalog which includes complete listing of military specifications. For specific needs, write, wire or phone us. Our research section is anxious to assist you.

McCoy

ELECTRONICS CO.
Dept. E-311
MT. HOLLY SPRINGS, PA.
Phone HUnter 6-3411
BE SURE TO SEE US AT
THE I. R. E. SHOW - BOOTH 2311

an operating temperature range of −65 to 165 C. Seventeen standard resistance values from 10 ohms to 50 K ohms are available. Standard tolerance is 5 percent. Size is 1.25 in. long by 0.28 wide by 0.31 deep. It can be mounted individually or stacked with standard 2-56 screws. It is available in 3 terminal configurations.

CIRCLE 372 ON READER SERVICE CARD



Vane Axial Blower weighs 3½ lb

AIR-MARINE MOTORS, INC., 369 Bayview Ave., Amityville, N. Y. Model E2543-200 far exceeds environmental tests set forth in MIL-E-5422D. It has application wherever maximum air and medium static pressure are paramount. Utilizing a 2⅞ in. diameter motor, the blower, at 10,500 rpm, will deliver 200 cfm at ¾ in. of water. It operates on a 200 v, 3 phase, 400 cycle source. Due to its design principles and Class F insulation, unit withstands an ambient of 85 C and has a life in excess of 5,000 hr. It also meets MIL-E-5400B. Housing dimensions are 4 in. diameter by 4½ in. long.

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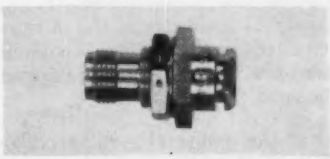

Coaxial Connectors for misssile use

KINGS ELECTRONICS CO., INC., 40 Marbledale Road, Tuckahoe, N. Y. Coaxial connectors plotted to enable users to select units which meet the desired vswr in critical applications can now be furnished in the 5,000-11,000 Mc range. Connectors have

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New design
New appearance

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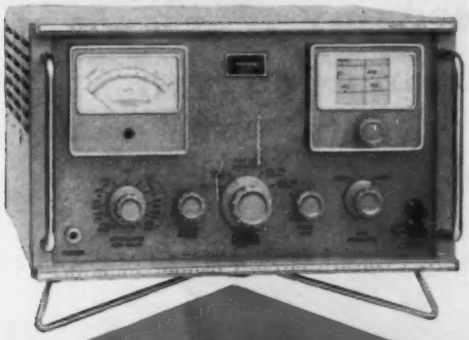

TUNABLE, dual selectivity
plus
Flat VTVM feature

Sierra Model 125A

FREQUENCY SELECTIVE VOLTMETER

Model 125A is an all-new vacuum tube voltmeter incorporating features of several previous Sierra instruments in one compact, high-performance instrument.

Covering the frequency range of 3 to 600 KC, this new voltmeter has both narrow and wide selectivity settings plus a flat voltmeter position. This triple mode measurement capability makes the Model 125A an extremely versatile instrument for carrier measurements, wave analysis and general laboratory use. Brief specifications are listed at the side. For full information and demonstration, call your Sierra representative or write direct.

SPECIFICATIONS

Frequency Range
Tunable Mode: 3 KC — 600 KC
Flat Mode: 1 KC — 600 KC

Measurement Range
Tunable Mode: –90 dbm to + 32 dbm
Flat Mode: –30 dbm to + 32 dbm

Selectivity
Narrow: down 3 db 125 cps off resonance
down 45 db 500 cps off resonance
Wide: down 3 db 1.25 KC off resonance
down 45 db 5 KC off resonance

Construction
Modular with etched glass epoxy circuit boards

Data subject to change without notice

sierra

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A Division of Philco Corporation

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an absolute reliability of vswr of 1.25:1 or better and are designed especially for missile and precision equipment. A calibration curve is supplied with each connector which can be tested and plotted at every 100 Mc point over the entire range if so desired. Both KA 11-06 and KA 51-05 connectors are part of the company's TNC group and are available for specific or broad band use. They meet government specifications.

CIRCLE 374 ON READER SERVICE CARD

Panel Meter 4½-in. model

GENERAL ELECTRIC CO., Schenectady 5, N. Y. Company's line of Big Look a-c and d-c panel meters has been augmented by the addition of a new 4½-in. model. Available for all standard voltages and current ratings, the instrument features a 3.93 in. scale length. Accuracy is ±2 percent. It can be supplied with custom-made scales to comply with customers' appearance design or color-coding requirements. Method of mounting is standard, conforming to the ASA C39.1 specification for 4½-in. panel meters.

CIRCLE 375 ON READER SERVICE CARD

Chassis Slides ultra-thin

JONATHAN MFG. CO., 720 E. Walnut, Fullerton, Calif. The ultra-thin series 140 and 150 precision ball bearing chassis slides are designed for applications requiring instant accessibility of electronic consoles for maintenance and interchange of rack mounted chassis. A push-button levering mechanism allows immediate release of inner slide member carrying the electronic chassis. There is no necessity of

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in heat controls for jet windshields

Convair 880 jet airliners are first to use new, advanced design anti-fogging, anti-icing heat control systems developed by Magnetic Controls Company.

Windshield icing and fogging problems are considerably more complex for jet airliners, compared with those encountered by piston engine planes. With jet travel, faster speeds, higher altitudes, plus greater extremes in temperatures and atmospheric pressures, many new problems develop. Magnetic Controls proportional heat control systems have helped to solve these problems for Convair 880 jets. The Magnetic Controls systems offer four distinct advantages:

- **Automatic compensation for windshield aging.**
- **Ultra-reliable, fully static design.**
- **Elimination of thermal shock for longer windshield life.**
- **Superior accuracy – proportional plus integral control.**

For complete information about this system and how it may help you obtain precise, accurate heat control for many applications, write or phone Magnetic Controls Company today.

MAGNETIC CONTROLS COMPANY

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Heat Control Systems • Static Inverters • Voltage Monitoring Systems

loosening or removing holding bolts. Load rated at up to 200 lb/pair, slide widths are available from ⅜ in. to ½ in. Tilting mechanisms permit 90 deg upward and downward swing of chassis for servicing ease. Positive locking of the slide assembly in fully extended position is provided.

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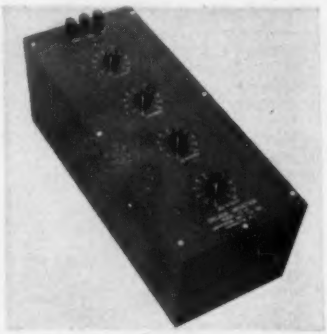

Decade Inductors highly accurate

UNIVERSAL MFG. CO., INC., 1168 Grove St., Irvington, N. J., offers a series of decade inductors useful for substitution in the design of equalizers and filters at audio and ultrasonic frequencies. Units feature moisture protected, low distributed capacity coils wound on temperature stabilized molybdenum permalloy cores. At 1 Kc the accuracy of the total inductance is ±1 percent.

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Toroidal Inductors microminiaturized

BURNELL & Co.,10 Pelham Parkway, Pelham, N. Y. The new MT series of Kernel toroidal inductors provide lightest weight, maximum reliability and considerable economy in p-c use. The MT34's are recommended for frequencies to 30 Kc and can be

Panoramic

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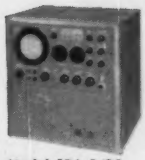
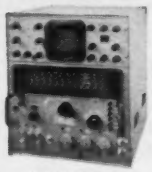
FREQUENCY RESPONSE PLOTTERS
COMMUNICATIONS SYSTEM ANALYZERS
TELEMETRY TEST INSTRUMENTS


Model SPA-3/25

SPECTRUM ANALYZERS

200cps to 44,000mc

Model SPA-3/25: 200cps-25mc—Versatile "workhorse" instrument for audio through r-f applications. Invaluable for video spectrum analysis.


Model SPA-4

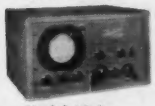
Model SPA-4: 10mc-44,000mc. Extreme sensitivity, adjustable IF filter width (1-80kc), 70 mc dispersion, ONE tuning head and other features for a wide variety of reliable measurements.

NOISE & VIBRATION ANALYZERS

0.5cps to 22.5kc

Model LF-2a

Model LF-2a: — 0.5cps-2500cps — Extreme stability, 0.1-20cps resolution (selectivity), "quick look" spectrum evaluation and inked chart readout for thorough analysis in Subsonic range.


Model LP-1a

Model LP-1a: 20cps-22.5kc—A time-proved spectrum analyzer for noise, vibration, harmonic, IM and complex waveform studies in many fields.

ULTRASONIC SPECTRUM ANALYZERS

0.1kc-525kc

Model SB-15a

Model SB-15a: 0.1kc to 525kc—Compact unit features extended range for distortion and vibration analysis, telemetry, communications systems monitoring. Sweep rate, center frequency, sweep width and IF Bandwidth continuously adjustable.

COMMUNICATIONS SYSTEMS ANALYZERS

Single Side Band

Model SSB-3a: 2mc-40mc—Comprehensive analysis with built-in high resolution spectrum analyzer, 2-tone Audio generator, stable tuning head, important self-checking features.

Model SSB-3a

NEW **Model TTG-2:** Distortion-free two-tone audio generator for transmitter testing.

NEW **Model TTG-5:** RF two-tone generator for receiver distortion testing, linear driver for transmitter power amplifiers.

NEW **REC-1:** Extends range of SSB-3a down to cover 100cps-2mc.

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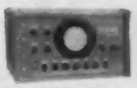
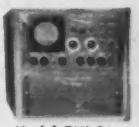
PANADAPTORS . . . uniquely suited to detect off-frequency transmissions, analyze interference caused by splatter, improper carrier location, spurious modulation, parasitics, etc.


Model SA-8b

TELEMETRY TEST INSTRUMENTS

Model TMI-1a: 350cps to 85kc Rapid monitoring of entire subcarrier spectrum, set up of subcarrier pre-emphasis, measuring and analyzing subcarrier distortions, many other telemetry applications.


Model TMI-1a

Model TMC-411: NEW simultaneous 11-point Telemetering Frequency Calibrator.

Model TMC-411

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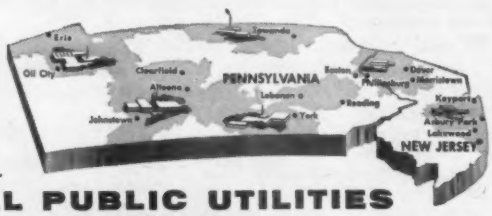
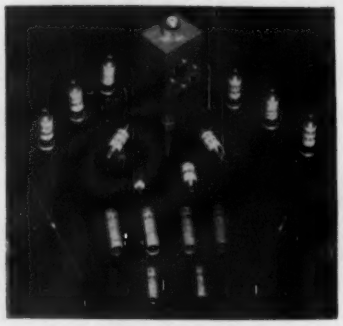


GENERAL PUBLIC UTILITIES CORPORATION

Att: Wm. J. Jamieson, Area Development Director, Dept. E-3
67 Broad St., New York 4, N. Y. WHitehall 3-5600

supplied with inductances up to 50 mhys. With inductances up to 200 mhys, MT 35 Kernels are applicable to frequencies ranging to 200 Kc. Q for the MT34 is greater than 55 at 25 Kc and for the MT35 more than 60 at 100 Kc. Size of the MT34 and 35 is 0.417 in. o-d by 0.215 in., spacing between leads, 0.3 in. by 1 in. long with a weight of 0.06 oz.

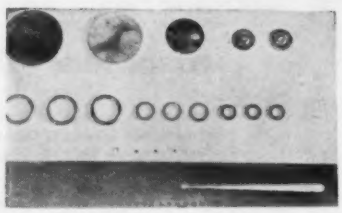
CIRCLE 378 ON READER SERVICE CARD



Microwave Diodes versatile line

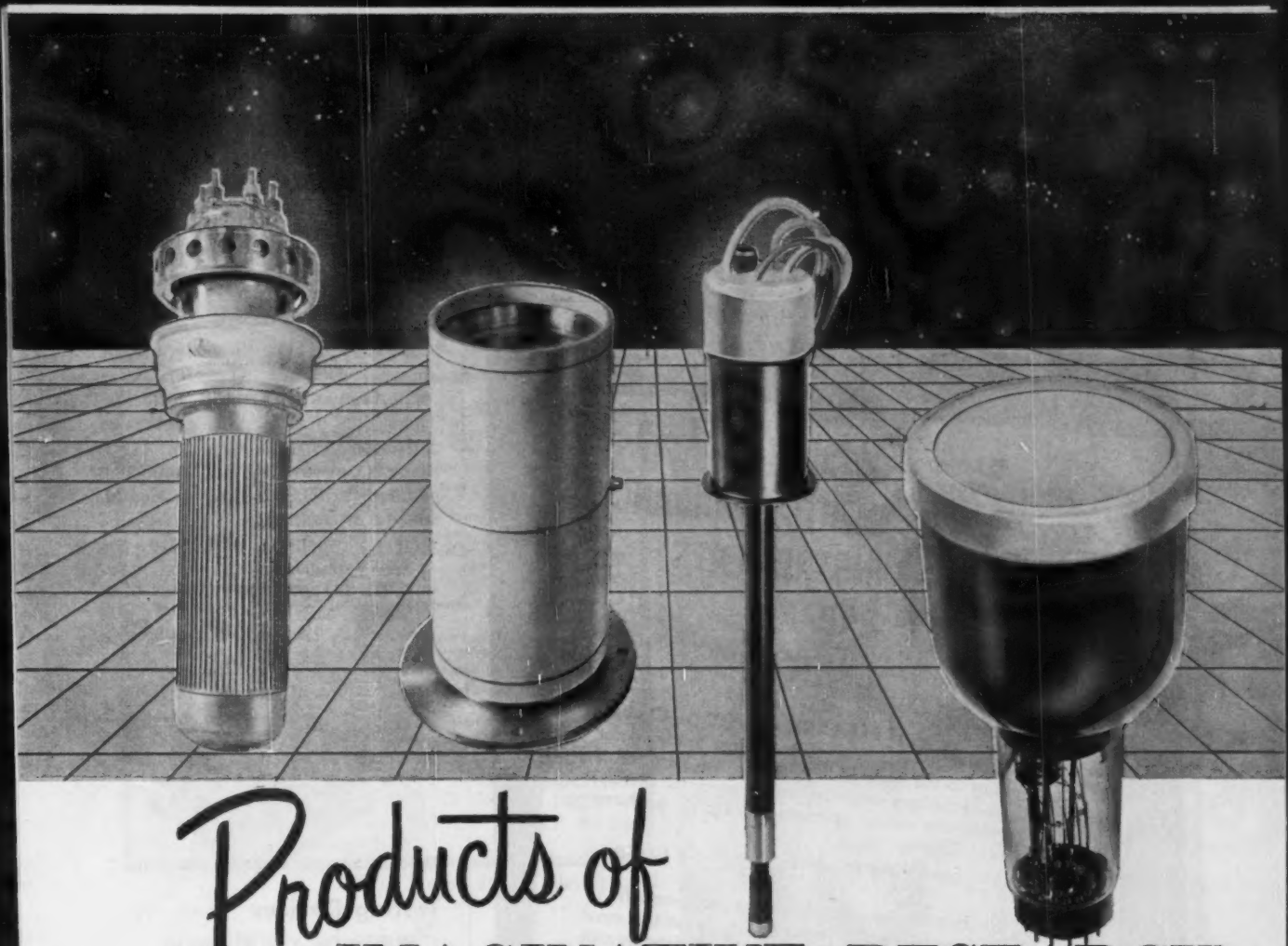
SYLVANIA ELECTRIC PRODUCTS INC., 730 Third Ave., New York 17, N. Y., has available various packages in its versatile microwave diode line. Company offers a wide range of mixer, detector and mesa structure in Varactor types, for cut-off frequency operation from 100 Mc to 100,000 Mc. The Micro-Min diodes are shown on extreme left and right of photo (lower half). There are 7 Micro-Min types (1N830, 1N830A, 1N831, 1N831A, 1N832, 1N833, 1N918) for use as uhf and X-band detectors, and S, X, and Ku-band mixers.

CIRCLE 379 ON READER SERVICE CARD



Microforms high purity

ANCHOR ALLOYS, INC., 968 Meeker Ave., Brooklyn 22, N. Y., has announced a wide variety of microforms. The most common elements



Products of IMAGINATIVE RESEARCH

Since the earliest days of the electron tube, the name of ITT has been in the forefront of tube development.
ITT Components Division offers the products of these years of experience and imaginative research — your most dependable source for special purpose electron tubes.

Federal Power Tubes

Used in military applications as pulse switch tubes, and for broadcast, industrial heating, and communications as amplifiers, oscillators or modulators, Federal tubes comprise the broadest range of power triodes available anywhere — ranging up to 225 KW anode dissipation. Several metal-ceramic types are now available.

Kuthe Hydrogen Thyratrons

Produced by the oldest and most experienced manufacturer of hydrogen thyratron tubes, with two decades of research and development background, Kuthe Hydrogen Thyratrons represent the ultimate in tubes for radar modulation and similar applications.

Kuthe offers the most complete family of Hydrogen Thyratrons available, including new ceramic-metal types to meet severe environmental conditions.

Also available is a complete line of Hydrogen Diodes and grid control rectifiers for special applications.

ITT Traveling Wave Tubes

The first traveling wave tubes manufactured and used commercially for microwave communications were ITT Tubes — forerunners of the outstanding family of traveling wave tubes now available, covering from 250 megacycles to 11,000 megacycles, providing 1 KW peak power over the entire frequency range.

These tubes are all ceramic-metal construction for extremely rugged CW or pulse service, meeting rigid government environmental requirements for microwave components.

ITT Display Tubes

The Iatron* family of display tubes — the most recent achievement in commercial tube development by ITT Components Division — features bright daylight viewing by image amplification and the ability to write, store and erase information at will. Intended for use in radar and similar electronic displays, Iatron* tubes are available in several sizes for direct or projection display applications.

Write or call TODAY for complete catalog or Engineering Data Sheets on the types you require.

IRE Booth Numbers 2510-2625

*Iatron is a trademark of International Telephone and Telegraph Corporation.

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SLIP RINGS* *talk to the leading specialist first*

Ultra-reliability for

GYROS
INERTIAL GUIDANCE
INSTRUMENTS
RADAR
SWITCHING

ENGINEERING — RESEARCH — PRODUCTION:
Electro-Tec's experienced engineers have made major contributions to the state of the art... exclusive electro-deposition technique employs pure precious metals, guaranteeing the utmost in contact integrity, performance, and reliability.
Three plants assure the reliability of multiple source of supply.
Write for information on miniature components to complete giant assemblies designed to meet the most stringent electrical, mechanical and environmental specifications.

*PAT. NO. 2,696,570 and other patents pending.

NEW MARK II RELAY
The First Wedge Action Relay

Insures ULTRA-reliability under most extreme environmental and operating conditions.

Revolutionary WEDGE ACTION supersedes and surpasses "wiping action."

- Temperature range:—65° C. to 200° C.
- Contact bounce: NONE.
  Operating vibration: 5 to 2,000 cps, 30 G's.
  Operating shock: 100 G.
- Contact rating: dry circuit to 2 amps.
- Extremely low contact resistance.

PAT. NO. 2,866,046

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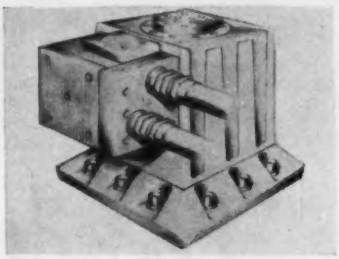
employed as emitters and collectors in semiconductors have been indium, aluminum, gallium, lead, tin, gold, silver, arsenic, antimony pure, binary or ternary alloys and composites consisting of solder, tin or gold clad one side, edge or center strips on such metals as molybdenum, tantalum, tungsten, nickel, kovar, etc. These microforms are manufactured to rigid specifications, blue prints and tolerances to suit specific requirements. Customers select purities from 99.9 percent to 99.999 pure, elemental, alloyed or composite, in the form of spheres, washers, dots, rings or specially shaped tabs.

CIRCLE 380 ON READER SERVICE CARD



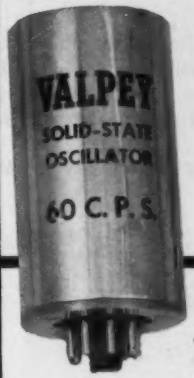
Testing Devices measure vibration

MB ELECTRONICS, a division of Textron Electronics, Inc., 781 Whalley Ave., New Haven 8, Conn. Electronic, electrodynamic and electrohydraulic equipment for controlled simulation and measurement of environmental vibration conditions. Heart of a system for calibrating velocity-type pickups and accelerometers is the MB C12 electrodynamic exciter. It provides a frequency range of 5 to 10,000 cps, maximum sinusoidal vector force of 150 lb. A complete line of electrohydraulic loading systems—27 MB models in all—producing 1,000 to 100,000 lb force output is also available.

CIRCLE 381 ON READER SERVICE CARD

Tiny Connectors meet Mil specs

THE DEUTSCH CO., Municipal Airport, Banning, Calif., has available a complete line of miniature connectors, including solder-type (DM series), solderless, snap-in type



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Crystal-Controlled
PACKAGED
OSCILLATORS

Valpey Crystal Corp., a reliable and long-established manufacturer of frequency control devices, now brings you a line of precision-made crystal-controlled packaged oscillators.

Transistor or tube types are available from 60 cps. to 10 mc. Standard units are offered for computer and commercial applications — with a minimum of lead time required. Our Engineering staff would be pleased to design custom units for severe environmental conditions and other special applications to meet your most particular requirements.

Valpey Crystal Corp., also manufactures a complete line of precision optics, quartz crystals and temperature control ovens for electronic, ultrasonic and optical applications.

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CIRCLE 341 ON READER SERVICE CARD

Two great Convair Jets get reliable connections through

GREMAR connectronics™ *

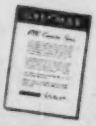
*Ⓣ Gremar Mfg. Co., Inc.

General Dynamics corporation's CONVAIR Division specifies Gremar RF connectors for its new 880 commercial jet, the world's fastest airliner. For reasons of top reliability Gremar RF connectors are also on their military B-58. Here's why . . .

GREMAR CONNECTRONICS concentrates engineering, production and quality control on RF connectors *only* . . . guarantees 100% conformance to your most exacting specs.

GREMAR DELIVERS . . . by stocking America's most complete line of RF connectors and fittings . . . by maintaining a shelf stock of more than 500,000 assembled units . . . of over 2,000 types . . . and 4,000,000 component parts ready for assembly!

SPECIFY GREMAR for top-level reliability and performance in RF connectors. Write for literature on any series of standard RF connectors . . . or send us your specs on special requirements.



Specialized high potential test equipment developed by Gremar determines voltage breakdown point up to 25 KV, just one of the 142 separate quality checks that make Gremar RF connectors specified on every major missile program.

GREMAR

GREMAR MANUFACTURING COMPANY, INC.
RELIABILITY THROUGH QUALITY CONTROL
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need reference data?

Look in the new

electronics BUYERS' GUIDE

Complete list of government buying agencies, specs and applications in 64 page reference section of the '59-'60 issue.

A McGRAW-HILL PUBLICATION
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New York 36, N. Y.

CIRCLE 221 ON READER SERVICE CARD

TEMPERATURE CONTROL EXPERIENCE

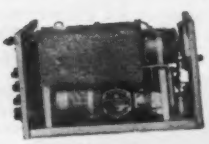
REFRIGERATION COOLING

Sensitive aircraft and missile components and systems often require temperature control within close limits – while ambient temperatures fluctuate widely. Eastern refrigeration-type cooling systems are ideal for such conditions.

Designed for the strictest military requirements, these vapor-cycle closed-system packages are built around a highly efficient compressor powered by a special 400-cycle motor. Unique condensing and special cooling methods are called upon to meet the most unusual operating requirements, the most demanding specifications.

Capacities range from 100 to 6000 watts; operating altitudes extend to 100,000 feet. Some units, of the "boil-off" type, perform almost without regard for extremes in altitude and temperature.

Call on Eastern for imaginative solutions to *all* avionic cooling problems . . . and write for new Bulletin 360.



other refrigeration units for aircraft and missile electronics

EASTERN INDUSTRIES INCORPORATED
100 SKIFF STREET
HAMDEN 14, CONN.

Eastern AVIATION PRODUCTS

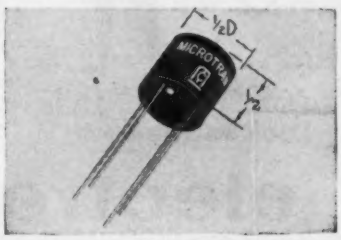
(DS series), hermetics and rack-and-panel connectors. These miniature connectors meet or exceed all applicable requirements of military specifications.

CIRCLE 382 ON READER SERVICE CARD

Time Delay Relay
10 percent accuracy

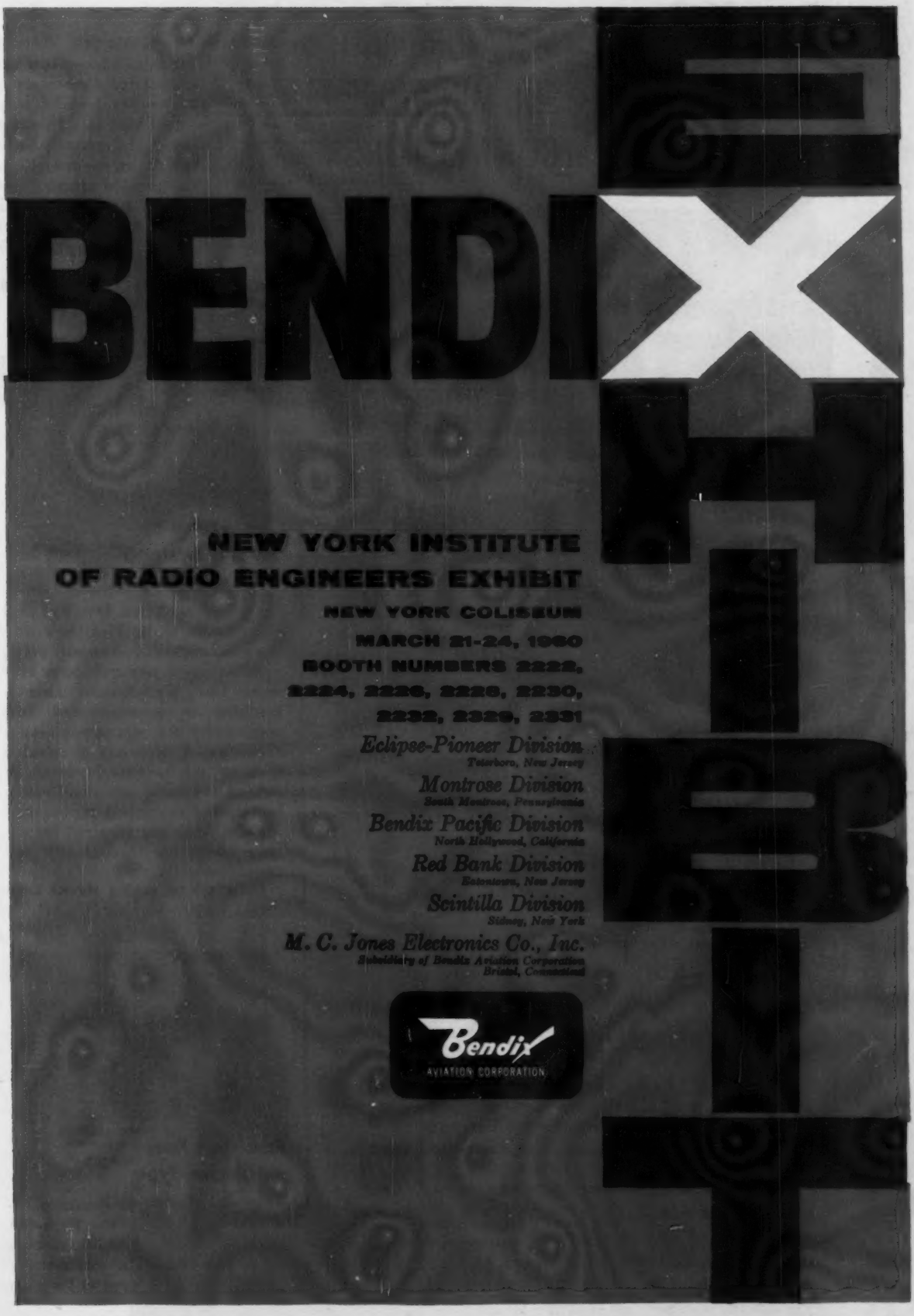
HI-G, INC., Bradley Field, Windsor Locks, Conn. Series 1100 time delay relay custom-designed with standard delay times of 50 msec to 3 minutes during operate or release cycle. Relays with longer delays or with delay during operate as well as release time are also available. Accuracies of 10 percent or better over severe environmental conditions up to a vibration of 20 g to 2,000 cps, temperatures of −65 C to +125 C and shock of 50 g. Contacts are available with ratings as high as 10 amperes. Either a-c or d-c source voltages may be specified.

CIRCLE 383 ON READER SERVICE CARD

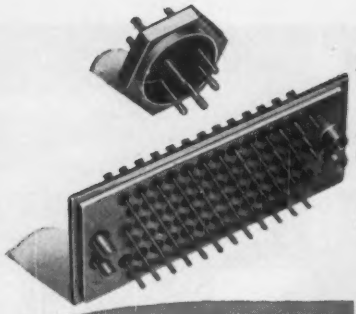


Tiny Transformers
epoxy molded

MICROTRAN CO., INC., 145 E. Mineola Ave., Valley Stream, N. Y. New transistor transformers weigh 4 grams. They are manufactured with nickel alloy cores of high permeability, nylon bobbins and Formvar wire. They are designed to meet MIL-T-27A, grade 5, class



CIRCLE 223 ON READER SERVICE CARD 223



MINIATURE AND SUB-MINIATURE CONNECTORS

ESCON INC.

A new high standard of connector quality and performance for Missiles, Aircraft, Computer and other Electronic Systems.

ESCON connectors meet all MIL-5015 and MIL-C-8384 (USAF) specifications and are available in all standard sizes and contact arrangements.

ESCON has the production capacity to assure fast delivery on both standard and special applications.

ESCON is an outstanding specialist in hermetic as well as standard connectors.

ESCON is unusually well prepared to create custom connectors, maintaining complete research and development facilities for engineering and testing special applications.

ESCON is able to ensure exacting quality control because all components are produced and assembled under one roof.

Look to ESCON for the solution of your connector design and delivery problems. Write for specifications literature.

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ESCON INC. A Subsidiary of GLASS-TITE Industries, Inc.

571-9

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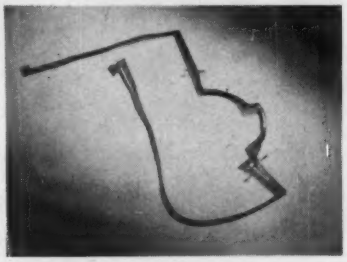
224 CIRCLE 224 ON READER SERVICE CARD

R, 10,000 hr reliable life. Tinned buss leads are supplied, enabling the units to be used for dip soldering in printed circuitry. Units may also be mounted flush in a fuse clip type assembly. Terminals are identified by a flat on one side. Electrical ratings provide primary impedances of 400 to 100,000 ohms and secondary impedances of 11 to 2,500 ohms. Wattage ranges from 2.5 mw to 8 mw.

CIRCLE 384 ON READER SERVICE CARD



Wiring Systems flexible

SANDERS ASSOCIATES, INC., 95 Canal St., Nashua, N. H. Flexible wiring designs, including twisted pairs, shielded cables, and multilayer harnesses of high-density circuits available as mass-produced unit components for equipment manufacturers. Preforming in pleated folds or coils permits harnesses to stretch and recoil into small space. In rotating equipment no connecting slip rings are required for devices oscillating through 360 deg and more.

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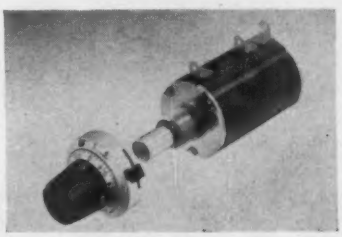

Precision Pots trimmer type

HELIPOT DIVISION of Beckman Instruments, Inc., 2500 Fullerton Road, Fullerton, Calif., announces three new trimmer potentiometers: model 7216, a $\frac{3}{8}$ in. diameter ten-turn

CIRCLE 225 ON READER SERVICE CARD→

YORK-HOOVER GUARANTEE

The York-Hoover Body Division occupies 350,000 square feet of modern manufacturing facilities. Highly skilled engineers, metal workers, welders and finishers take traditional Pennsylvania Dutch pride in producing this top quality Shelter S-141.

This is your guarantee, backed by 67 years of creative engineering and production "know how."

YORK-HOOVER

announces the new electronic shelter S-141

IN MISSILRY . . . as a tracking center

IN COMMUNICATIONS . . . as a microwave center

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MIL-S-52059 (Sig C)

IN RAPID AIR TRANSIT . . . as a shipping container

EXCLUSIVE FEATURES

ALL WELDED CONSTRUCTION—Inert arc welded aluminum frame resistance welded to the outer skin results in the most rugged and reliable semi-monocoque construction.

SQUARE INSIDE CORNERS—Maximum internal space utilization is achieved; simplified corner installation of ducting, raceways and equipments is permitted.

LIGHTWEIGHT CONSTRUCTION—The unique combination of high strength to weight ratio foams results in the lightest weight sandwich panel construction consistent with military specifications.

REPLACEABLE SKIDS—Designed to permit easy replacement of skids.

FLEXIBLE DESIGN WITH MINIMUM COST—The York-Hoover shelter design lends itself to maximum individual custom requirements, such as, access openings, internal reinforcements, overall dimensions and similar modifications.

TESTED AND APPROVED—The York-Hoover S-141 Shelter has been tested and complies with U. S. Army Signal Corps specification.

For assistance in the Selection and Arrangement of Equipment and Components, write for:
Preliminary Layout Form-Shelters Form #H-160

York-Hoover Loading Device permits simple and reliable loading of shelters on military type trucks in all terrains.

YORK-HOOVER CORPORATION

YORK PENNA.

Creative Engineering for Industrial and Military Products Since 1892

Write for Bulletin No. 949

NOW you can Zipper-Tube
100 feet of cable in seconds with the new
ALPHLEX® CLOSING TOOL for ZIPPER TUBING*. . .

*Patents =RE24,613 and =2,558,367, and other patents

FREE with each order of 1000 or more feet of Alphlex Zipper Tubing. Designed specifically to save you time, labor and money in your cable production requirements, the unique new Alphlex Zip-2000 Closing Tool forms, closes and seals Alphlex Zipper Tubing in one easy motion — faster and more positively than ever before. Just lay your wires on the flat Zipper Tubing, insert the zipper tracks in the openings of the Tool, pull the Tool along the cable's length—zip!—that's it! The Tool forms the tube, closes the tracks, permanently seals the jacket—fast, *in seconds.*

PERFORMANCE-PROVEN ALPHLEX® ZIPPER TUBING

For your every harnessing, cabling and jacketing need, the complete line of Alphlex Zipper Tubing comprises 6 types and 17 sizes each, from ¼" to 4" I.D.—and is used by such leaders as IBM, IT&T, Lockheed, Martin, Sperry Rand, U.S. Government agencies, etc.

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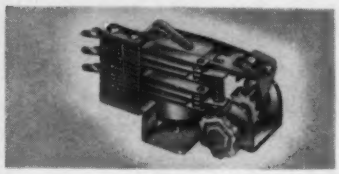
number (illustrated with a turns-counting dial); model 70, a ⅜ in. square trimmer; and model 71, ½ in. square pin-type unit for use in printed circuitry.

CIRCLE 386 ON READER SERVICE CARD



Impulse Relay long life

GUARDIAN ELECTRIC MFG. CO., 1621 W. Walnut St., Chicago 12, Ill. Series 670 impulse relay is designed to insure long life trouble free operation well in excess of one million steps. Each momentary impulse (up to 10 steps per sec) causes relay to reverse its cam actuated contacts. Contact arrangements up to dpdt, with ratings to 1,500 w noninductive, or up to 20 amperes locked motor current, motor load control on 115 v, 60 cycles. Coil voltages to 230 v a-c or 110 v d-c. Applications include on/off control of lights, motors, speakers, etc.

CIRCLE 387 ON READER SERVICE CARD

Rack Adapter provides flexibility

ALDEN PRODUCTS CO., 117 N. Main St., Brockton 64, Mass. A new "picture frame" rack adapter makes it possible to subdivide circuitry into modular plug-in units within a single, rack-mounted assembly. Combinations of 2 in., 4 in., 8 in. or one 17 in. chassis plug into the rack adapter which in turn mounts in any standard relay rack or specifically in Alden unit racks for greater flexibility and servicing ease. This functionally subdivided rack module can be included in line

CECO

Low Noise

VHF and UHF

Amplifiers and Preamplifiers

SERIES 1000

For application as receiver preamplifiers or wide band i. f. amplifiers . . . in scatter communications systems, laboratory, or nuclear research. Eight standard models cover VHF and UHF to 900 mc. High gain, low noise. Special pass bands available.

Advanced techniques permit modification of standard units at minimum cost.

Write for complete details:

COMMUNITY ENGINEERING CORPORATION

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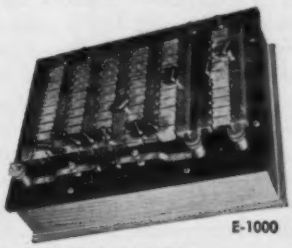
PRECISION INSTRUMENTS
FOR
STANDARDIZING LABORATORIES



E-1000

ANTHONY PATTERN
WHEATSTONE BRIDGE

RESISTANCE STDS.
"REICHANSTALT and
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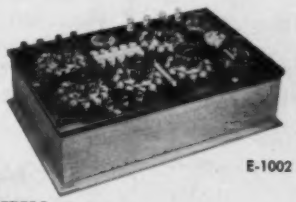
MUELLER BRIDGE
FOR
PRECISE TEMPERATURE
MEASUREMENTS WITH
PLATINUM RESISTANCE
THERMOMETERS



E-1002

LABORATORY AND
DEFLECTION POTENTIOMETERS

OUR FACILITIES ARE AVAILABLE FOR CALIBRATION & CERTIFICATION

BASED ON OUR OWN NATL. BUREAU OF STD CERTIFIED STANDARDS.

GRAY INSTRUMENT COMPANY
448 MILL ROAD
ANDALUSIA, PA.

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PROVEN RELIABILITY—
SOLID-STATE POWER INVERTERS,
over 260,000 logged operational hours—
voltage-regulated, frequency-controlled,
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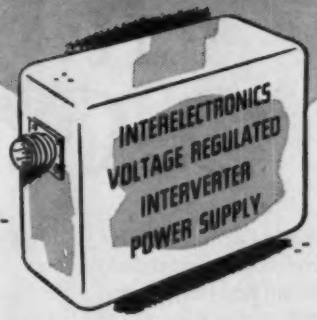
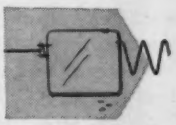
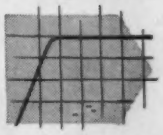
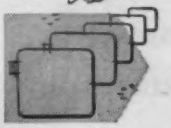
135°C all-silicon units available now—









Interelectronics all-silicon thyratron-like gating elements and cubic-grain toroidal magnetic components convert DC to any desired number of AC or DC outputs from 1 to 10,000 watts.

Ultra-reliable in operation (over 260,000 logged hours), no moving parts, unharmed by shorting output or reversing input polarity. High conversion efficiency (to 92%, including voltage regulation by Interelectronics patented reflex high-efficiency magnetic amplifier circuitry.)

Light weight (to 6 watts/oz.), compact (to 8 watts/cu. in.), low ripple (to 0.01 mv. p-p), excellent voltage regulation (to 0.1%), precise frequency control (to 0.2% with Interelectronics extreme environment magnetostrictive standards or to 0.0001% with fork or piezoelectric standards.)

Complies with MIL specs. for shock (100G 11 misc.), acceleration (100G 15 min.), vibration (100G 5 to 5,000 cps.), temperature (to 150 degrees C), RF noise (I-26600).

AC single and polyphase units supply sine waveform output (to 2% harmonics), will deliver up to ten times rated line current into a short circuit or actuate MIL type magnetic circuit breakers or fuses, will start gyros and motors with starting current surges up to ten times normal operating line current.

Now in use in major missiles, powering telemeter transmitters, radar beacons, electronic equipment. Single and polyphase units now power airborne and marine missile gyros, synchros, servos, magnetic amplifiers.

Interelectronics—first and most experienced in the solid-state power supply field produces its own all-silicon solid-state gating elements, all high flux density magnetic components, high temperature ultra-reliable film capacitors and components, has complete facilities and know how—has designed and delivered more working KVA than any other firm!

For complete engineering data, write Interelectronics today, or call LUdlow 4-6200 in New York.

INTERELECTRONICS CORP.
2432 Gr. Concourse, N. Y. 58, N. Y.

CIRCLE 227 ON READER SERVICE CARD

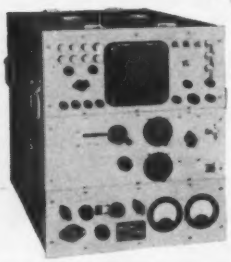
A STATEMENT OF POLICY FROM G.C.C.

General Communication Company has made important contributions towards advancing the state of the art in the design and manufacture of specialized test equipment and sub-systems for aircraft and missiles.

With the arrival of the second generation of missiles and the approach of the space age, more stringent requirements will be made on components and techniques to satisfy these sophisticated systems. G.C.C. intends to continue to serve weapon-systems groups through the improvement of existing products, and the development of new techniques, particularly in the fields of precision measurement and calibration standards.

***G.C.C. Offers* Advanced Electronic Capabilities in the fields of:**

- MISSILE ELECTRONICS
- GROUND CHECKOUT AND TEST EQUIPMENT
- NAVIGATION AND SURVEILLANCE EQUIPMENT
- MICROWAVE EQUIPMENT
- SPECIAL INSTRUMENTATION



Model PCS-1A

G.C.C. has developed, and is now producing for Industry and the National Defense . . . Pulse Power Calibrators, Coaxial Switches, Radar Beacons, Signal Generators.

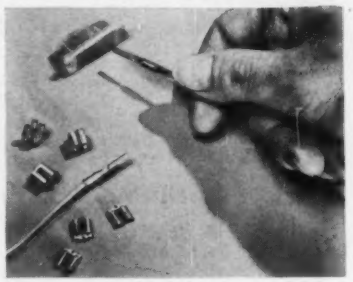
General Communication Company

677 Beacon Street Boston 15, Mass.

creative electronics

with other rack mounted units making up electronic systems. Since it is an independent, self-contained unit, it can be conveniently moved from one installation and included in another.

CIRCLE 388 ON READER SERVICE CARD



Taper Pin Connectors die cast

GRIES REPRODUCER CORP., 151 Beechwood St., New Rochelle, N. Y., announces zinc die cast taper pin connectors. Because the units must generally be produced in complex shapes, thin cross sections, close tolerances and in large volume, many receptacle designs have taken advantage of the fully automatic die casting technique developed by GRC. The design illustrated is based on multiples of 2 and 4 taper pin holders. At one end a connection is made by a wire crimped into a notch formed in the "bridge" between the receptacles. At the other end a taper pin is inserted. Originally these parts were formed progressively from sheet metal plus soldering in a costly operation. The modular construction made possible by die casting speeds servicing by eliminating the disconnect and reconnect work necessary with soldered units.

CIRCLE 389 ON READER SERVICE CARD

Static Inverters precision frequency

MAGNETIC AMPLIFIERS, INC., 632 Tinton Ave., New York 55, N. Y. A line of static inverters, designed for aircraft, missile and ground guidance application, operate from a nominal 28 v d-c supply and provide regulated 115 v 400 cps 1 phase or 3 phase outputs. Power ratings are from 30 va to 1,500 va. Em-

electronics buyers' guide and reference issue
THE ELECTRONICS MAN'S BASIC BUYING BOOK

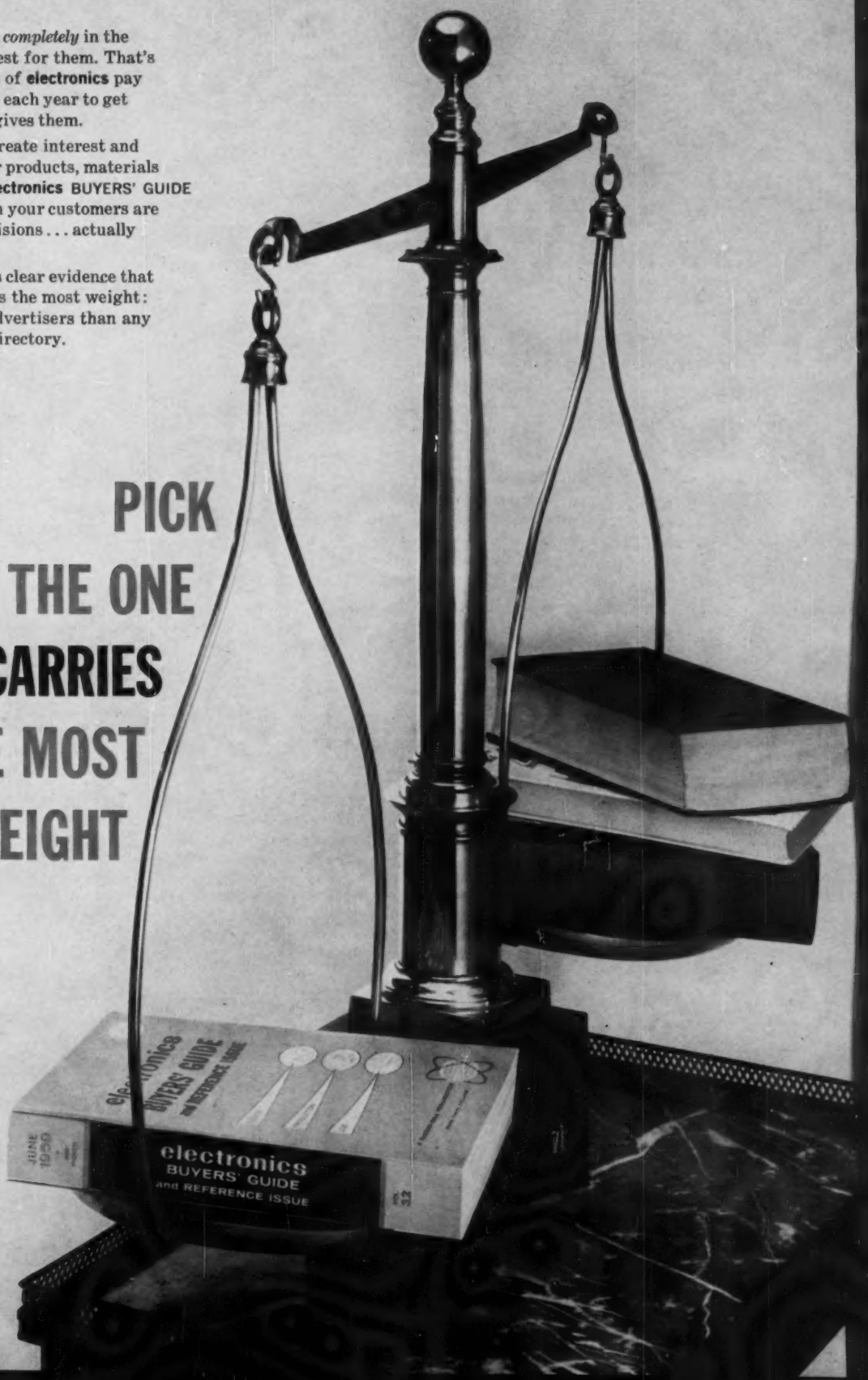
A McGRAW-HILL PUBLICATION
330 West 42nd St., New York 36, N. Y.

People believe most *completely* in the things that work best for them. That's why 52,000 readers of **electronics** pay more than $300,000 each year to get the information it gives them.

Use **electronics** to create interest and acceptance for your products, materials or services. The **electronics** BUYERS' GUIDE gets you there when your customers are making buying decisions . . . actually sells for you.

Exclusive! There is clear evidence that the "GUIDE" carries the most weight: it has 42% more advertisers than any other electronics directory.

PICK THE ONE THAT CARRIES THE MOST WEIGHT



9.53

DIGISYN® ENCODERS

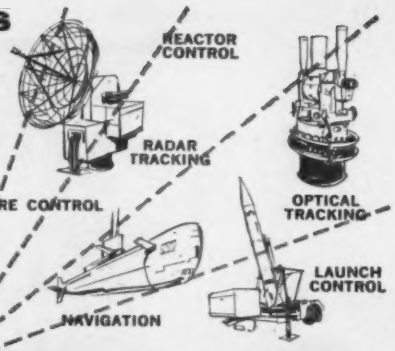
for precision in:

Radar and Optical Tracking

Navigation and Guidance Systems

Missile Launch Control

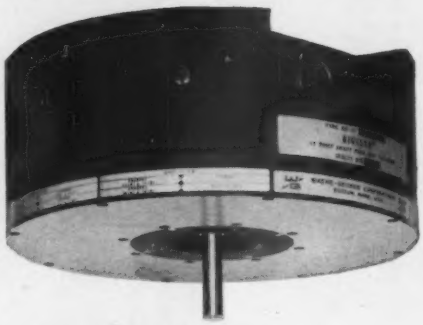
Nuclear Reactor Control



W-G

NEW RD-17

Photoelectric Shaft Position Encoder



DIGISYN® RD-17

The Ultra-Precise Encoder

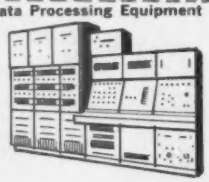
- 17-digit accuracy in 10" diameter — 10-second resolution without gearing
- Self-contained amplifiers and control electronics
- Self-contained power supplies — 115 Volts, 60 cps or 400 cps input power
- Solid or Hollow Shaft Input
- Serial or Parallel Digital Readout
- Modular construction — easy maintenance

When you need the ultimate in accuracy, the utmost in reliability, the maximum in performance, the minimum in maintenance — specify DIGISYN® Shaft Position Encoders. They provide a direct, single-step method of digitizing the angular position of a shaft, meet military specifications, and function in environmental extremes.

For full information on the new, ultra-precise RD-17 or other DIGISYN® encoders and accessories, write today, or call (Boston) COpley 7-8425.

Standard & Custom Encoders

Data Processing Equipment



W-G

WAYNE-GEORGE

CORPORATION

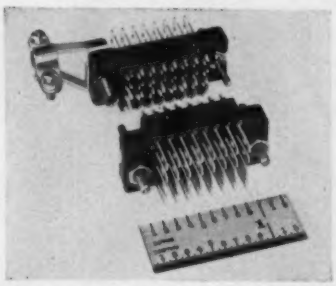
(ADCON DIVISION)

588 COMMONWEALTH AVENUE • BOSTON 15, MASS.

See us at I.R.E.—Booth #3232

phasis of design is high reliability, small size and weight. Features include: short circuit protection with automatic recovery, phase locking circuitry, reverse voltage protection, magnetic amplifier regulator, transient voltage suppression, modular construction, low distortion, and high shock, vibration and environment.

CIRCLE 390 ON READER SERVICE CARD



Tiny Connector high reliability

ELCO CORP., "M" St. below Erie Ave., Philadelphia 24, Pa. Series 8105 connector is of the rack-and-panel type, with high contact density. Contacts are Varicons, assuring high reliability and low contact resistance under all typical environmental conditions during the entire life of the equipment. Connector is of hermaphroditic design with both mating insulators exactly alike except for their contact numbering. The mating contact area extends 50 percent above the insulator surface and 50 percent below it, inside the insulator contact holes. Connector illustrated has 4 rows of 8 contacts; spacing between contacts is 0.100 in. and 0.125 in. between rows.

CIRCLE 391 ON READER SERVICE CARD

R&D Kits ferrite components

FERROXCUBE CORP. OF AMERICA, Saugerties, N. Y. Engineers pioneering new products requiring ferrite magnetic cores, voltage dependent resistors, memory cores, planes or stacks will ease their problems with Ferroxkits. The kits make it possible to: (1) immediately obtain necessary components for making initial investigations;

Precise

Temperature Control ±½° F From -100°F to +500°F

ACCURATE TEMPERATURE CONTROL, without overshoot and without drift.

•

SAVES TIME by bringing the environment to the engineer instead of scheduling time in large, slow chambers.

•

VERSATILE—test for high and low temperatures in the same chamber.

•

AUTOMATIC CYCLING timer is available as auxiliary equipment.

•

Other chamber sizes and models are also available.

•

DELTA DESIGN, Inc.

Sales Office
7460 GIRARD AVENUE
LA JOLLA, CALIF.
GLencourt 4-1185 TWX: LAJ 6453

CIRCLE 348 ON READER SERVICE CARD

VALUABLE 64 PAGE REFERENCE SECTION

in electronics BUYERS' GUIDE

Prepared especially by the 25-man editorial staff of *electronics*, this 64-page section is designed to assist the buyer by providing him with market data, electronics applications, market distribution, market reports and books, industry organizations and services.

electronics BUYERS' GUIDE and Reference Issue

A McGraw-Hill Publication
330 West 42nd Street
New York 36, New York

...IT GLOWS *when the* FUSE BLOWS!

NEW INDICATING 3AG FUSE POSTS

EXAMINE THESE FEATURES

1. New patented knob design to assure high degree of illumination for instant blown fuse indication.
2. Positive finger grip for knob extraction.
3. Quick service bayonet lock.
4. Constant tension beryllium copper coil & leaf spring for positive contact & lower millivolt drop.
5. Optional—at extra cost—neoprene "O" ring to assure splash-proof feature.
6. New high degree vacuum neon lamp for greater brilliance & visibility.
7. Impact black phenolic material in accordance with MIL-M-14E type CFG.
8. One piece brass hot tin dipped non-turning bottom terminal.
9. Double flats on body to permit mounting versatility.

SPECIFICATIONS:

PART #	VOLTAGE RANGE
344006	2½- 7 volts
344012	7 - 16 volts
344024	16 - 32 volts
344125	90 -125 volts
344250	200 -250 volts

Maximum current rating 20 amps.

PHYSICAL CHARACTERISTICS—Overall length 2⅜" with fuse inserted • Front of panel length 1³⁄₁₆" • Back of panel length 1⁹⁄₁₆" • Panel area front 1³⁄₁₆" dia. • Panel area back 1³⁄₁₆" dia. • Mounting hole size (D hole) ⅝" dia. flat at one side.

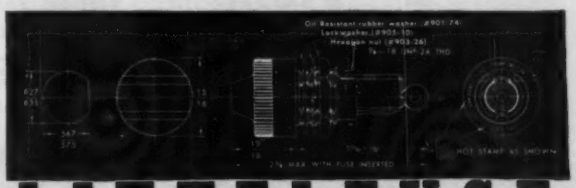
TERMINAL—Side—one piece, .025 brass—electro-tin plated • Bottom—one piece, lead free brass, hot tin dipped.

KNOB—High temperature styrene (amber with incandescent bulbs —2½ thru 32 volts—and clear with high degree vacuum neon bulbs—90 thru 250 volts) • Extractor Method—Bayonet, spring grip in cap.

HARDWARE—Hexagon nut—steel, zinc cronak or zinc iridite finish • Interlock lock washer—steel, cadmium plated • Oil resistant rubber washer.

MILITARY SPECIFICATIONS—MIL-M-14E type CFG. Fungus treatment available upon request per Jan-T-152 & Jan-C-173.

TORQUE—Unit will withstand 15 inch lbs. mounting torque.



LITTELFUSE

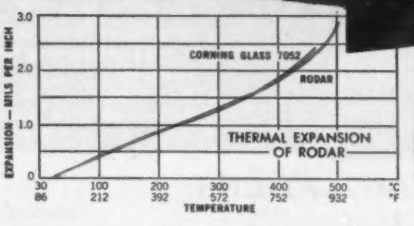
DES PLAINES, ILLINOIS

CIRCLE 231 ON READER SERVICE CARD 231

THE *Specialized* ALLOY
FOR GLASS HERMETIC SEALS

RODAR®

...ASSURES *Permanently Bonded* VACUUM-TIGHT SEALS!



Another Special Alloy for a Specific Purpose

This precision alloy was developed for sealing metal to hard glass. Wilbur B. Driver Rodar is processed from melting to finished size in our own plant under the strictest controls to insure consistent analysis, temper, uniform grain size and conformance to customers' specifications. The superior stamping and sealing properties of Rodar make it *the preferred sealing alloy.*

Rodar produces a permanent, vacuum-tight seal with simple oxidation procedure and resists attack by mercury. Readily machined and fabricated, Rodar can be welded, soldered or brazed. Available in wire, strip and bar to your specifications.

PROPERTIES

Composition (Nominal)
Nickel 29%
Cobalt 17%
Manganese . . .30%
Iron . . . . . Balance

Melting Point
. . 1450°C. (Approx.)

Specific Gravity . . 8.36

Weight Per Cubic Inch
. . . . . .302 lb.

Electrical Resistivity
. . . 294 Ohms C.M.F.

Tensile Strength
. . . . . 90,000 PSI

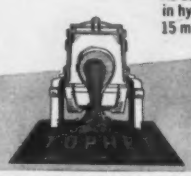
Hardness
. . . . 82 B Rockwell

Elongation
30% (2" gauge length)

VISIT BOOTHS 4201-4203 I.R.E. SHOW!

Temperature Range	Average Thermal Expansion, *Cm/Cm/°Cx10-6
30° To 200 C.	4.33 To 5.30
30° To 300 C.	4.41 To 5.17
30° To 400 C.	4.54 To 5.08
30° To 450 C.	5.03 To 5.37
30° To 500 C.	5.71 To 6.21

*As determined from cooling curves, after annealing in hydrogen for one hour at 900°C. and for 15 minutes at 1100°C.



WILBUR B. DRIVER CO.
NEWARK 4, NEW JERSEY

IN CANADA: Canadian Wilbur B. Driver Company, Ltd., 50 Ronson Drive, Rexdale (Toronto)

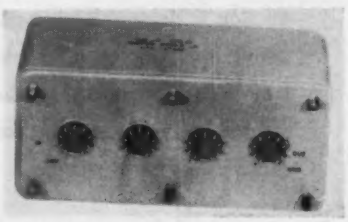
(2) select the proper part for optimum performance and (3) lower prototype cost by providing required items in experimental quantities instead of large lots. Kits range from $10 to $395 each.

CIRCLE 392 ON READER SERVICE CARD

Parabolic Antennas large size

ANDREW CORP., 363 E. 75th St., Chicago 19, Ill. The Hubloc antennas feature high surface accuracy, high rigidity to weight factor, easy installation and light weight for given windload rating. Construction of back frame is accomplished with two basic elements: tubular bars and connecting hubs fabricated for press fit connection eliminating welding or special tools for assembly. Sizes range up to 60 ft in diameter.

CIRCLE 393 ON READER SERVICE CARD



Delay Line 32 taps

COLUMBIA TECHNICAL CORP., 61-02 Thirty-First Ave., Woodside 77, N. Y. Type L748C delay line combines high ratio of delay time to rise time, delay accuracy, extremely low insertion loss and temperature

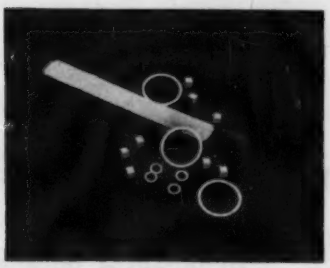
coefficient. Designed as a lumped parameter network, it is hermetically sealed and meets all applicable requirements of MIL-STD-202. Total delay is 6.5 μsec ±0.5 percent; rise time, 0.135 μsec; impedance, 470 ohms; insertion loss, 0.7 db; temperature coefficient of delay, 25 ppm/deg C; size, 6 in. by 3 in. by 2¾ in.; weight, 3 lb.

CIRCLE 394 ON READER SERVICE CARD

Power Oscillator precision unit

ELIN DIVISION, International Electronic Research Corp., 145 W. Magnolia Blvd., Burbank, Calif. The DK-115-14 precision power oscillator is a 15 w unit with 1,000 and 100 v outputs. Principal feature is super-regulation which gives the user identical regulation of greater than 0.1 percent on both outputs. Also featured is the encapsulation of the temperature-sensitive bridge elements in a constant temperature oven, assuring utmost voltage stability. Unit is also available in other voltage arrangements, and frequency range from 200 cps to 10 Kc. Dimensions are 5¼ in. high, 8 in. deep, 19 in. wide, relay rack mounted. Price is $795.

CIRCLE 395 ON READER SERVICE CARD



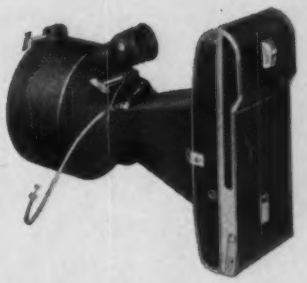
Gold Preforms many shapes

ALPHA METALS, INC., 56 Water St., Jersey City 4, N.J., has available miniature gold preforms used in the manufacture of semiconductor devices. They are used as a high-

FAST . . . LOW-COST

'Scope Recording

for Immediate, Single Prints—ETC Model SM-200 uses the well-known *"Polaroid Land"* Camera Back, f:1.9 Wollensak lens and Alphax shutter in a special ETC-designed mounting. Gives *actual size* finished prints in 1 minute or positive slides in 2 minutes after exposure. You don't have to be a photographer to make perfect oscilloscope recordings with this camera. Only $325. with f:1.9 lens, monocular viewer and telescoping unipod.



for Continuous Recording—The unusually versatile ETC Model SM-100 makes accurate, moving film recordings at speeds from ½" to 12,000" per minute. Uses 35 mm film or paper. *"Variac"* speed control and tachometer eliminate warmup. Uses f:1.5 Wollensak lens and Alphax shutter with speeds 1 to 1/100 second for data card exposure. Includes timing marker lamp, removable 400' magazines (1000' optional), binocular viewer. Only $985 with f:1.5 lens. Rack & pinion, tilt-mount tripod adjustable for *all* standard 5" scopes. Includes carry case.

Write for Complete Specifications

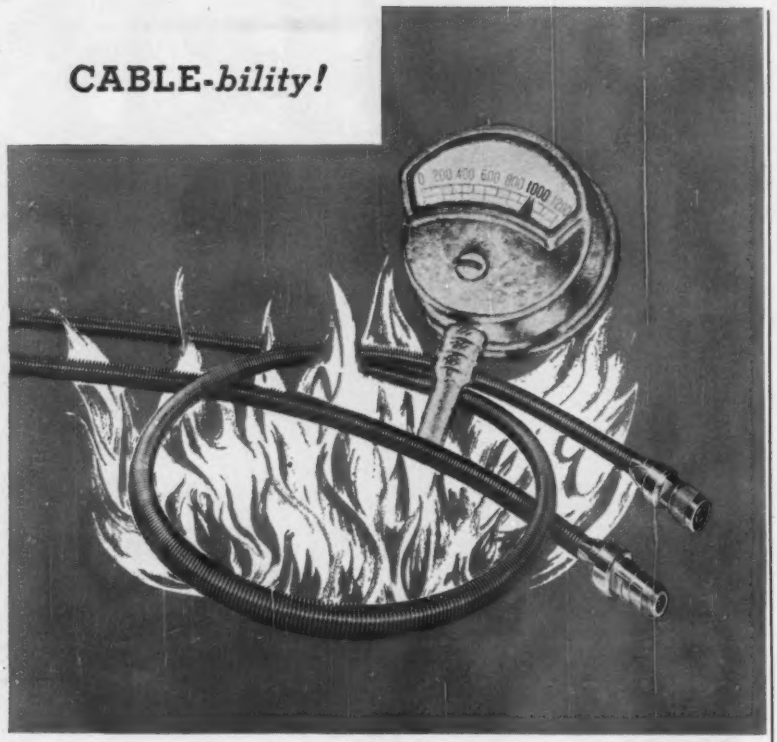
HEADQUARTERS FOR OSCILLOGRAPHY—Dependable scope recording cameras are a natural outgrowth of ETC research. ETC produces a complete line of 1-, 2-, and 4-channel oscilloscopes and multi-beam cathode-ray tubes for military and industrial applications. Send for full details on any product.

electronic tube corporation

1200 E. MERMAID LANE, PHILADELPHIA 18, PA.

VISIT US AT THE I.R.E. SHOW—BOOTHS 3112-3113

CABLE-*bility!*



A CABLE SYSTEM OPERATES AT 1000°F CONTINUOUSLY!

The biggest news in coaxial cables during 1959 was the development by AMPHENOL Cable & Wire Division of flexible RF cable that operates at 1000°F continuously. Obviously of tremendous value in aircraft and missile applications, where temperatures of this order are commonly encountered, the 1000°F system is also being used in two other vital areas:

1. High temperature applications between the highest possible limit of RG-/U cables (482°F) and 1000°F. Electrical characteristics in this range are excellent.
2. Nuclear applications. The 1000°F system is resistant to nuclear radiation and is ideal in reactor use. The flexibility of the cable gives added value in nucleonics.

The cable system is furnished with 1000°F Series N terminations and in standard lengths up to 200 feet. It is altitude insensitive and moisture resistant; it's resistant, as well, to shock and vibration.

A flexible RF cable system capable of operation at ultra-high temperatures and in nuclear environments is another example of AMPHENOL Cable & Wire Division's CABLE-*bility!*

AMPHENOL

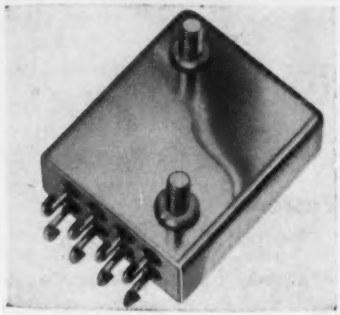
CABLE & WIRE DIVISION

S. HARLEM AVE. at 63rd St., CHICAGO 38

Amphenol-Borg Electronics Corporation

it cuts to desired lengths insulation tubing from reels and simultaneously places them on one or both leads of resistors, capacitors, etc. The cut insulation tubing, no matter how short, can be positioned to the body of the component. The leads are then cut and formed to loops or other bends preparing them for assembly use, thereby securing the spaghetti. The combination can handle tubing from ⅜ in. to 1¼ in. long which is placed on the straight leads of axial components. Using the hand wheel attachment the formed leads are adjustable in length in a matter of seconds.

CIRCLE 400 ON READER SERVICE CARD



Latching Relay subminiature

BABCOCK RELAYS, INC., 1640 Monrovia Ave., Costa Mesa, Calif. The subminiature BR-9 series 10 ampere magnetic latching relay will operate on as little as 100 mw. It weighs approximately 1 oz and features minimum life expectancy of 100,000 cycles at 125 C. Series is shock-rated at 50 g, 11 millisec with 30 g vibration, 10-2,000 cps. MIL-R-5757 C and 25018 specifications are fully met. Available in dpdt with maximum coil dissipation of 3 w.

CIRCLE 401 ON READER SERVICE CARD

D-C Amplifier differential type

PACKARD BELL COMPUTER, 1905 Armacost Ave., Los Angeles 25, Calif. Outstanding features of the model 361 differential d-c amplifier include: 120 db common mode rejection with 200 Kc bandwidth at a gain of 1,000; over 100 megohm

input impedance; 10 μsec settling time to 0.01 percent of final value; noise and drift referred to the input—20 μv ± 10 μv; and completely solid state including chopper.

CIRCLE 402 ON READER SERVICE CARD

Readout transistorized

BURROUGHS CORP., P.O. Box 1266, Plainfield, N. J. The Trixie (transister driver plus Nixie indicator tube) readout comprises ten medium-voltage *npn* transistors in a common emitter configuration with each transistor driving one of the Nixie indicator tube's ten cathodes. Result is said to be the lowest power visual readout available. Circuit design takes advantage of low cost *npn* type transistors operating in a breakdown condition, where the current is limited by the Nixie indicator tube. This results in negligible current being drawn by the nine "off" cathodes and prevents damage to the transistor junction. The Trixie readout modules can be triggered by signals as low as 3 v, requiring currents of only 300 μa.

CIRCLE 403 ON READER SERVICE CARD

Power Oscillator and phase shifter

INDUSTRIAL TEST EQUIPMENT CO., 55 E. 11th St., New York, N. Y. Model OPS-100 consists of an 8-w power oscillator and a precision

NEW Couch Relay isolates Contacts from Contamination

Organic material can't contaminate the contacts in the new Couch Type 2M micro-miniature relay. They're hermetically sealed in a separate chamber — and without rosin flux.

Also contributing to reliability is Couch's patented rotary armature, pivoted on two sapphire jewels and virtually immune to present day levels of shock and vibration.

Designs like this, produced within an unusually narrow range of manufacturing tolerances, help explain why Couch relays are being called on to provide reliability in many complex systems.

Write for additional information.

ENGINEERING DATA:

Shock	50G Min.
Vibration	30G's to 2,000 CPS
Dielectric Strength	1000 Volts RMS Min.
Height	.875" max.
Width	.800" max.
Thickness	.400" max.
Weight	18 ± 1 gram
Contact Arrangement	2 form C(2 PDT)

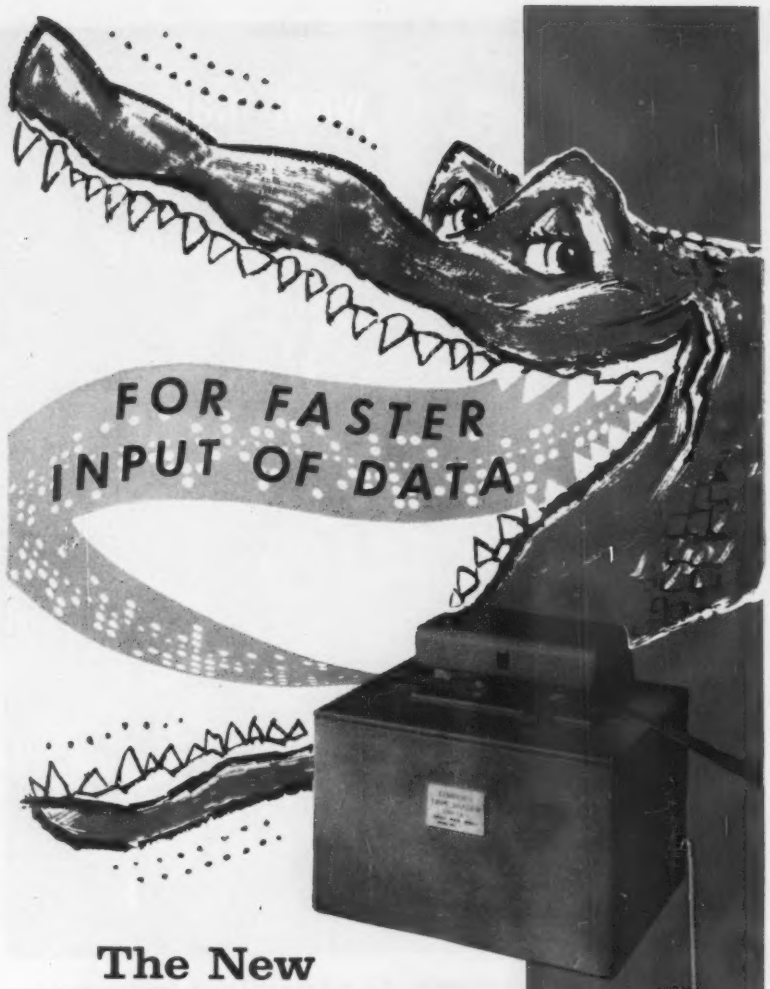
Couch

COUCH ORDNANCE, INC.

A Subsidiary of S. H. Couch Company, Inc.

3 Arlington St., North Quincy 71, Mass. Tel.: (Boston) BLuehills 8-4147

CIRCLE 237 ON READER SERVICE CARD 237



The New FERRANTI TR5 Transistorized Tape Reader

This is an advanced design embodying broad experience gained from earlier Ferranti tape reader models.

It employs new transistorized circuits and a photoelectric system of reading . . . offers the advantage of speedier input of data, compactness, light weight.

Many design features to meet practical requirements of the user. Power supply is self-contained.

Write for detailed information.

TAPE WIDTHS:
5, 6, 7 or 8 level, all types and colors.

SPEED:
Any speed up to 330 chars/sec, under external control.

ELECTRONICS:
All solid state, including solar cell reading head, signal amplifiers, logical circuits, control circuits and power supplies.

INPUTS:
115V 60 cps 115 Watts power, —2 V 100 microamp start signal.

OUTPUTS:
8 signal outputs, — 1.5 to — 3.5 V 5 milliamps plus reader ready signal.

SIZE:
9¼" x 11½" x 10". Weight 32 lbs.

FINISH:
Gray wrinkle.

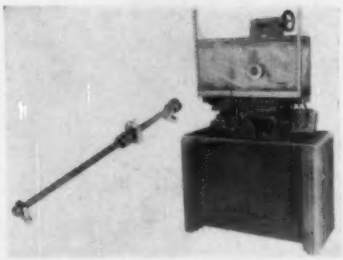
FERRANTI

FERRANTI ELECTRIC, INC.
ELECTRONICS DIVISION
95 MADISON AVE., HEMPSTEAD, N.Y.

238 CIRCLE 238 ON READER SERVICE CARD

variable phase shifter having a range of 90 deg ±10 deg. Resolution and incremental accuracy of the phase shifter is 0.05 deg. Absolute accuracy is better than 0.25 deg throughout its range, and better than 0.1 deg at the 90 deg point. Power oscillator can be used to excite the amplifier or component under test. Standard frequency is 400 cps; however, other frequencies can be supplied.

CIRCLE 404 ON READER SERVICE CARD



Wafering Machine
Roton table drive

MICROMECH MFG. CORP., 1020 Commerce Ave., Union, N. J., has developed the Roton table drive model of the Micro-Matic precision wafering machine. New drive insures greater production efficiency in cutting germanium, silicon and other difficult to work materials. The Roton, by providing a rolling rather than sliding fit between screw and nut, gives a virtually frictionless drive thus allowing better slow speed control, higher rapid return speed as well as eliminating motor burnout. The new development can be adapted for use on existing Micro-Matic precision wafering machines model WMA.

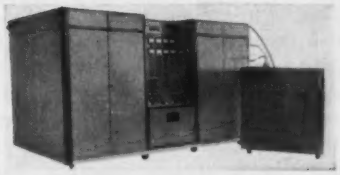
CIRCLE 405 ON READER SERVICE CARD

A-C Voltage Standard
accurate and stable

KIN TEL, a division of Cohu Electronics, Inc., 5725 Kearney Villa Road, San Diego 12, Calif. Model 601A has an output voltage from 1 to 501 v rms a-c, adjustable in tenth-volt steps and between tenth-volt steps by a multiturn pot. Power output capability is 5 amperes up to 5 v and 25 w above 5 v. Frequencies selectable by front panel

control are 60, 400 and 1,000 cps. Voltage accuracy is 0.1 percent or ±5 mv, whichever is greater. Short term voltage stability is 0.01 percent. Frequency stability is 1.0 percent and harmonic distortion is less than 0.3 percent.

CIRCLE 406 ON READER SERVICE CARD



Pulse Modulator
high voltage

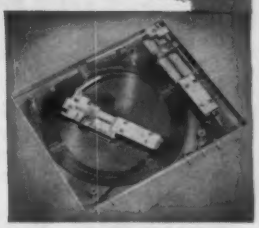
MANSON LABORATORIES, INC., 375 Fairfield Ave., Stamford, Conn. Model 330 provides a continuously adjustable pulse width range of 1 to 15 μsec at repetition rates of 100 to 1,000 pps. Pulse energy to the primary of the pulse transformer, which is housed in a separate cabinet, is 20 Kv peak at 600 amperes. Designed for a 0.002 duty cycle, the equipment delivers a maximum average power of 24 Kw. Equipment includes monitoring circuits for observing both output pulse voltage and current, as well as meters for all pertinent a-c and d-c voltages and currents. A low-capacity filament supply for the tube under test is also incorporated.

CIRCLE 407 ON READER SERVICE CARD

Transistor Guard
fast acting

SINCLAIR RADIO LABORATORIES LTD., P.O. Box 179, Downsview, Ontario, Canada. Model 101 transistor guard is designed especially for low power transistor applications where accidental burn-out is an ever-present danger. Unit also provides protection for the power supply against overload or short circuit conditions. Supply voltage range is 4-80 v d-c; trip current range, 12-500 ma; turn

No moving parts in FERRANTI Magnetostriction Delay Lines



Ferranti engineers have a depth of experience unmatched in this specialty.
We can provide stock units that have been proved in performance — or custom design to your special applications.

Features that characterize Ferranti Delay Lines:
Temperature stable . . . wide temperature operating range . . . High digit rates up to 1 Mc/s for delays up to 3 milliseconds . . . Small size, light weight . . . No moving parts . . . Low cost, highly reliable elements for delay, storage and correlation — fixed and variable.

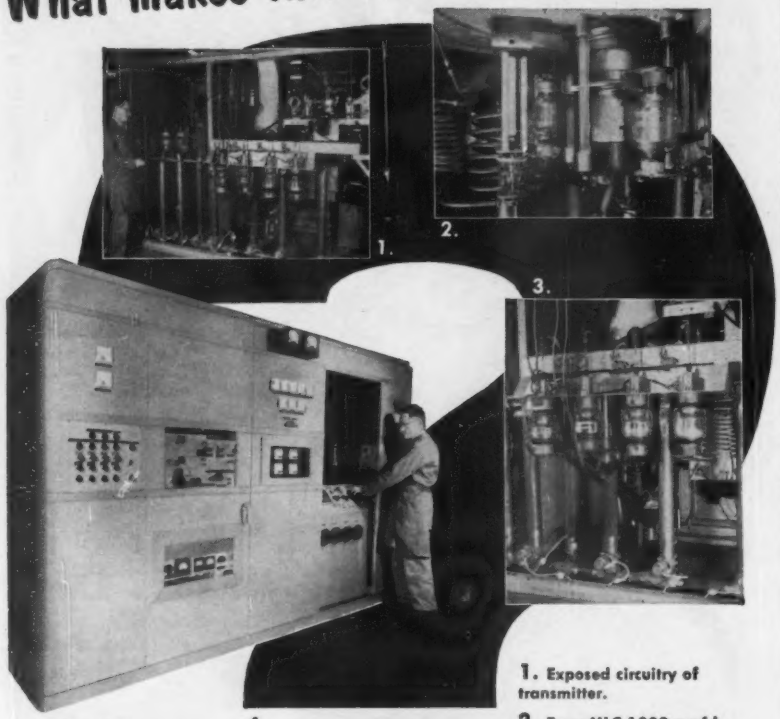
Write for detailed literature

FERRANTI

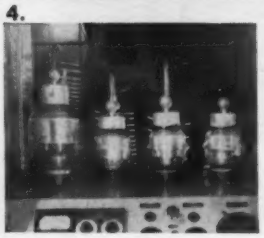
FERRANTI ELECTRIC, INC.
ELECTRONICS DIVISION
95 MADISON AVENUE HEMPSTEAD, N. Y.

CIRCLE 239 ON READER SERVICE CARD 239

What makes this transmitter possible?



100 KW BANDSWITCHING TRANSMITTER ELIMINATES TUNED INDUCTANCES



1. Exposed circuitry of transmitter.

2. Type MLC 1000 mmfd. vacuum capacitors for plate blocking. Band switching is accomplished with Type R1 vacuum switches.

3. Type VMMHC vacuum capacitors in the plate tank circuit. Switching from each output tank to a common load is done with Type RC10 vacuum coaxial relays.

4. Vacuum capacitors in the output tuned circuit.

This 100 kw transmitter is used to test and establish ratings on Jennings high voltage vacuum components. The testing program may require rapid frequency changes to 2, 4, 8, 16 and 32 mc. Each band is tuned by motor driven vacuum capacitors. Single dial panel switching between bands is accomplished with vacuum relays.

Fixed inductances were desired in the tank circuit in order to avoid problems of maintenance and resetability associated with transmitters that use tap switches and sliding contacts. This was made possible by taking advantage of the low minimum capacitances, small size, and low inductance of vacuum variable capacitors. This circuitry would be particularly useful in any rf transmitter design demanding daily repetitive frequency changes.

Space reduction and efficiency were further improved by using Jennings vacuum relays with their high voltage and current carrying capabilities. The sealed contacts are clean and remain clean because they are free of all oxides and contaminants. In addition vacuum relays never need maintenance.

Write for our new vacuum component catalog summary. It may suggest the answer to some of your present high voltage problems

RELIABILITY MEANS VACUUM
VACUUM MEANS Jennings®

JENNINGS RADIO MANUFACTURING CORPORATION · 970 McLAUGHLIN AVE. P. O. BOX 1278 · SAN JOSE 8, CALIF.

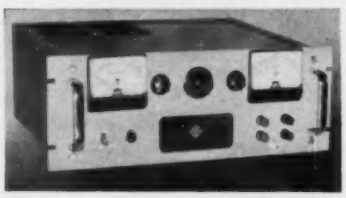
off time, 250 μsec; power supply drain, 13 ma maximum; physical size, 4 in. by 4 in. by 2 in.

CIRCLE 408 ON READER SERVICE CARD

Compacting Press for components

F. J. STOKES CORP., 5500 Tabor Road, Philadelphia 20, Pa. Model F-4 versatile compacting press is a 4-ton single-punch unit which is ideal for making hermetic seals, tantalum capacitor anodes, barium titanate shapes, ferrite cores, glass beads, tv-gun mounts, and other electronic components. The F-4 press compresses from both top and bottom, which makes it especially suited for producing pieces of high density, and can make parts up to 1¼ in. in diameter and 1¼ in. depth of fill at production rates from 34 to 50 pieces per minute.

CIRCLE 409 ON READER SERVICE CARD



Power Supplies 19 models

MID-EASTERN ELECTRONICS, INC., 32 Commerce St., Springfield, N. J., announces the ST series (19 models) of semiconductor power supplies. They feature line regulation of 0.005 percent; load regulation, 0.05 percent (at 18 v); ripple, less than 500 μv; more power output per given size. Interchangeable plug-in subassemblies are common to all 19 models. They are short circuit proof. Overshoot is less than 1.0 percent; recovery, 50 μsec. Series regulating transistors are protected against overvoltage by Zener diodes.

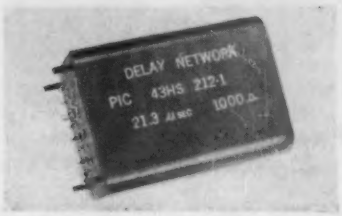
CIRCLE 410 ON READER SERVICE CARD

Digital Modules for military use

COMPUTER CONTROL CO., INC., 983 Concord St., Framingham, Mass.,

announces the MIL-T series, a line of dynamic, 1 Mc digital modules to conform with military specifications MIL-E-4159, 5400 and 16400. This series has been developed and designed to withstand Type 1 vibration, class A shock of MIL-E-16400, to operate in 95 deg humidity and condensation, and at temperatures between zero and +65 C. All unit delay lines and pulse transformers are encapsulated.

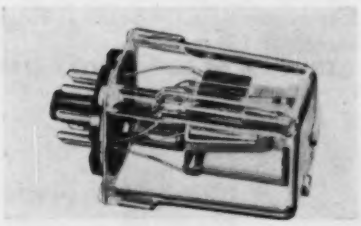
CIRCLE 411 ON READER SERVICE CARD



Delay Networks lumped constant

POLYPHASE INSTRUMENT CO., East Fourth St., Bridgeport, Montgomery Co., Pa., announces a new group of standard lumped constant delay lines. Evolving from custom designed units which PIC has supplied, these new standard cataloged items offer a wide range of specifications to meet the increasing demand for precision delay networks.

CIRCLE 412 ON READER SERVICE CARD



Plug-in Relay transparent cover

MAGNECRAFT ELECTRIC CO., 3352 W. Grand Ave., Chicago 51, Ill. Operating visibility, combined with protection against tampering, dust, iron filings and so forth, is provided by a new plastic cover for class 33 plug-in-mounted relays. Cover is made of high-impact strength styrene which also insulates the relay from electrical interference with other components. Relay can be

YOU WRITE THE SPECS...

WE MAKE THE CUSTOM CABLE

CABLE A

CABLE B

Neoprene Jacket

Braided Copper Shield

Polyethylene Insulation

Tinned Copper Shield

Conductors to MIL-W-16878C

Polyvinylchloride Jacket

Polyvinylchloride Jacket

Coaxial Cable

Silver-plated Shield

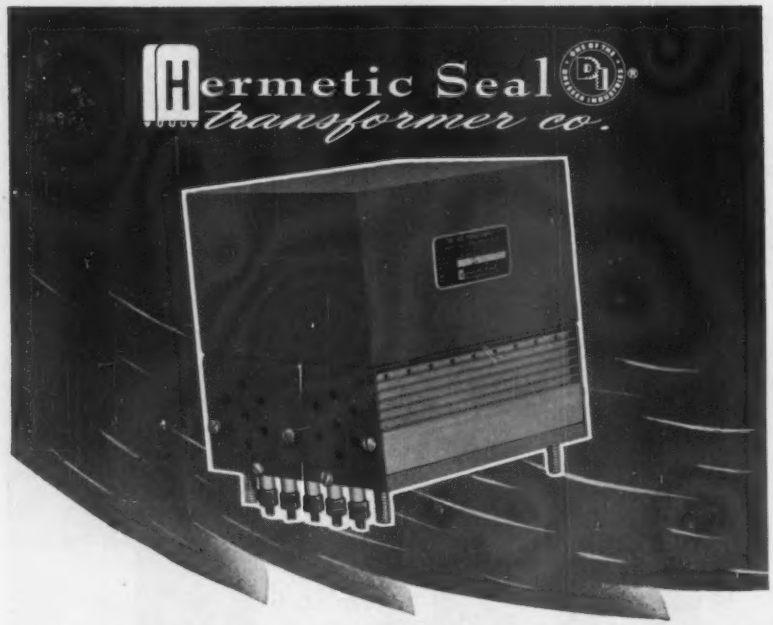
Above are two examples of Alpha's diversified range of custom cabling capabilities — to meet MIL or your own specifications. There are virtually no minimum quantities required. In fact, the complete order for Cable B called for 10 sections each of 13-feet 4-inch lengths.

Wire & Cable • ALPHLEX® Tubing & Sleeving • Lacing Cord

ALPHA WIRE CORPORATION • 200 Varick Street, New York 14, N. Y. • AL 5-5400

Pacific Division, 1871 So. Orange Drive, Los Angeles 19, California • WE 8-9141

IRE BOOTH 4103 • IRE BOOTH 4103 • IRE BOOTH 4103 • IRE BOOTH 4103 • IRE BOOTH 4103



Miniaturized POWER SUPPLIES
FOR WIDE LOAD AND LINE VARIATIONS

Designed and manufactured to operate from an auxiliary power source such as an unmanned microwave station, these power supplies provide a wide input frequency range, offer transient and short-term short-circuit protection, and are complete with terminals for external output fusing.

SPECIFICATIONS Model No. PAI-040

ELECTRICAL CHARACTERISTICS:

INPUT: 108 to 132 V, 47 to 420 cycles

OUTPUT: $200V_{DC} \pm 1\%$ at any load between 100 to 200 MA and at any input between 108 to 132 V, 47 to 420 cycles

RIPPLE: (Max) $300MV_{RMS}$ @ 47 cycle —$200MV_{RMS}$ @ 60 cycle —$10MV_{RMS}$ @ 400 cycle

ENVIRONMENT CONDITIONS:

AMBIENT TEMPERATURE: Operating
— 40°C to + 30°C
— 30°C to + 55°C with forced air cooling

ALTITUDE: Operating 10,000 ft. Non-Operating 40,000 ft.

HUMIDITY: 95% RH 40°C 240 HR (Mil-Std-202 Method 103)

SHOCK: 30 g's (Mil-S-4456)

VIBRATION: .060" Total Excursion 10-55 cycles (Mil-Std-202 Method 201A)

MECHANICAL CHARACTERISTICS:

SIZE: 4¼" x 5" x 4¾" WEIGHT: Less than 13 lbs. MOUNTING: Four # ¼-20 Studs

WRITE FOR BULLETIN NPB-104

HST Special Products Division specializes in the design and production of power supplies for radar range circuits, tracking circuits, computers, and built-in control or evaluator portions of equipment. *Comparable supplies are available in commercial counterparts.* Please invite us to quote on your next special production requirements.

Hermetic Seal transformer co.

MAGNETIC IRON-CORE COMPONENTS
ENVIRONMENTAL TESTING
POWER SUPPLIES—SERVO AMPLIFIERS

DRESSER INDUSTRIES INC.

ELECTRONIC
OIL • GAS
CHEMICAL
INDUSTRIAL

SPECIAL PRODUCTS DIVISION
2925 Merrell Road Dallas 29, Texas Phone FLeetwood 7-4348

242 CIRCLE 242 ON READER SERVICE CARD

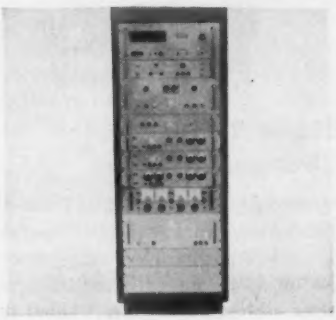
furnished for d-c operation with contact combinations to 3 pdt. Enclosure is available with 8- or 12-pin octal style plug which mates with Amphenol socket 77MIP-8, -12, or equivalent. Overall dimensions, including plug, 2⅛ long by 1⅜ in. square.

CIRCLE 413 ON READER SERVICE CARD

Power Levelers
microwave

MENLO PARK ENGINEERING, 711 Hamilton Ave., Menlo Park, Calif. Series 500 microwave power levelers are used to control output power variations from a traveling wave amplifier or backward wave oscillator. This is accomplished by a feedback process, whereby a sample of the output power is used to generate an error signal that is impressed on the amplitude modulation element of the twa or bwo. Precise power leveling can be performed regardless of the fact that the output power from the controlled device may be a rapidly varying function with respect to time, or may be swept in frequency to rates exceeding 100 cps.

CIRCLE 414 ON READER SERVICE CARD



Transistor Test Set
automatic system

OPTIMIZED DEVICES, INC., 864 Franklin Ave., Thornwood, N. Y. Model 1500 automatic transistor

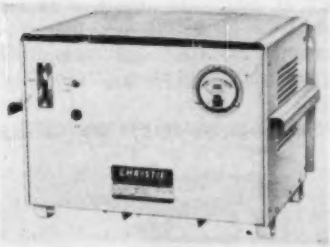
test set is a modular system capable of measuring a large variety of semiconductor parameters on a GO, NO-GO basis. Tests are performed in rapid sequence by a scanning mechanism controlled by the GO, NO-GO decision. Test models and limits are programmed in advance. Indicators provide identification of the test in progress and the test result. Equipment is included to provide digital or printed readout, manual or automatic program control, and unlimited flexibility of sequence events. One automatic system performing ten tests on each transistor can accept or reject approximately 500 transistors per hr with a single untrained operator. Model 1500 is accurate to 1 percent and fail-safe.

CIRCLE 415 ON READER SERVICE CARD

Teflon Coax Cables miniaturized

INSO ELECTRONIC PRODUCTS, INC., Union, N. J., announces a new line of miniature Teflon coaxial cables. Types RG-187/U, RG-188/U, RG-195/U and RG-196/U are manufactured to MIL-C-17. Samples and technical data are available.

CIRCLE 416 ON READER SERVICE CARD



Battery Chargers fully automatic

CHRISTIE ELECTRIC CORP., 3410 W. 67th St., Los Angeles 43, Calif., announces a complete line of automatic battery chargers for lead acid, nickel cadmium, silver zinc, silver cadmium and Edison batteries. All units employ highest quality silicon power rectifiers; and for stability and reliability silicon diodes are also used in the control circuit. Standard line includes models ranging from 6 to 120 v, 0-125 amperes output. Close end voltage regulation (±1 percent) is

SPECIAL MINIATURE SWITCHES

PRINTED CIRCUIT: 0.031" dia. terminals on last deck mount in printed circuit boards up to 1/16" thick. Up to 6 decks may be ganged.

DUAL SHAFTS: Up to 8 decks may be ganged. 1/8" dia. inner shaft may control up to 4 decks or other devices—rheostats, pots, condensers, etc.

SPRING RETURN. 1- or 2-way actions. Up to 8 positions each side of rest position. Up to 4 decks, shorting or non-shorting.

CLUSTER ARM: Up to 32 fingers. May be ganged with standard decks.

New Versatility...

Compactness...Low Cost...

Here is the traditional reliability of instrument-type switches . . . with a great variety of electrical and mechanical features . . . in a compact design that measures only 1¾" square by 1" for the first deck, 9/16" for each additional deck.

Readily tailored for almost any application, Shallcross **MINIATURE SWITCHES** handle not only r-f, plate and filament currents, but also 60- and 400-cycle power and metering circuits, maintaining a contact resistance of only 0.002 ohms for a minimum of 10,000 operations.

The basic design has silver alloy, multi-leaf wiper arms and button contacts with 1 to 32 positions per pole, 1 to 4 poles per deck, 1 to 19 decks, shorting or non-shorting action. Nylon bushings, alkyd rotors and glass-epoxy stators provide superior strength, wear, insulation, temperature and moisture characteristics.

Shallcross' unique semi-automatic assembly using stock parts insures quick delivery of the exact switches for your requirements. Complete details on this important new switch series will gladly be sent on request by SHALLCROSS MANUFACTURING CO., Selma, North Carolina.

Shallcross

See Us At The IRE Show—Booth 2634

How United States Testing Company helps

CUT COST & TIME OF COMPONENT TESTING 5 WAYS

Engineers who know where a component will "give", and test *there* first...plus complete evaluation facilities...all mean low cost component testing... high reliability...and quick service at United States Testing Company. Here's what you get:

Automated Reliability Testing— machine-recorded, error-free readings of 0.1% accuracy, every 3 seconds.

Complete Environmental Facilities— vibration, acceleration, shock, altitude, humidity, temperature, rain, immersion, fungus, salt spray, sand and dust.

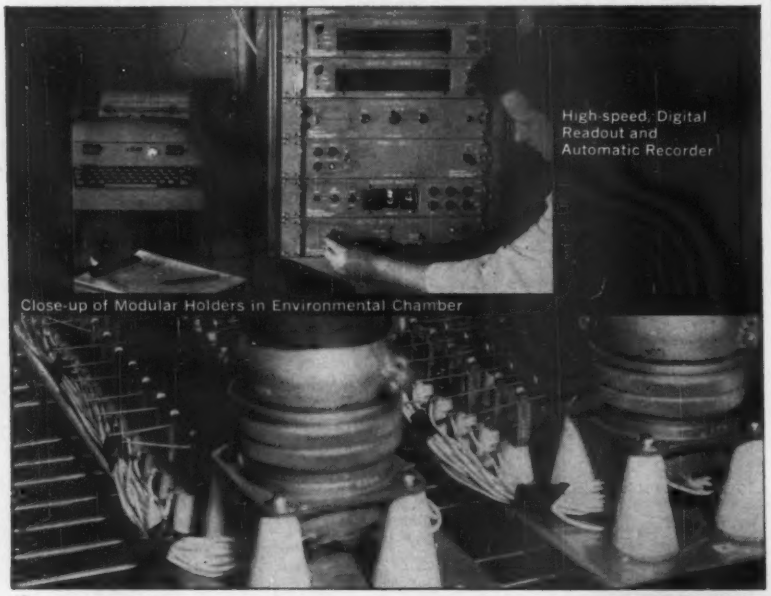
Experienced Evaluation Engineers— who spot weakness and potential failure.

Economical Handling of Your Peak Loads— quick take-over; costs you less than adding permanent staff.

Product Qualification Tests—recognized by government and military for placing your product on the Qualified Products List.

See how United States Testing Company can cut the cost and time of your component testing. Phone or write for quotation.

RESISTORS · TRANSFORMERS · TRANSISTORS · DIODES · CAPACITORS · RELAYS · SWITCHES



17

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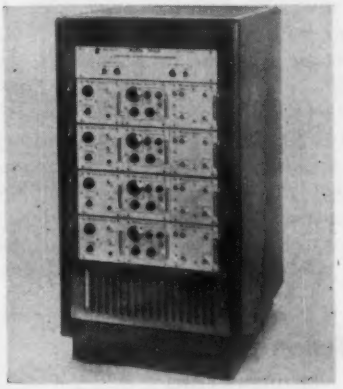
maintained for a change in a-c line voltage of ±10 percent. Current limiting holds the charging current always within a safe value. A convenient "Float" and "Charge" switch on the front panel provides easy selection of desired output.

CIRCLE 417 ON READER SERVICE CARD



Pulse Generator four-channel

ELECTRO-PULSE, INC., 11861 Teale St., Culver City, Calif. Four-channel millimicrosecond current pulse generator, model 3010A, operates to frequencies in excess of 3 Mc, delivering 0.04 μsec rise time outputs at 1 ampere for wide use in test of magnetic or other current driven devices. It provides four variable width and amplitude pulses, two positive and two negative.

CIRCLE 418 ON READER SERVICE CARD

Silicon Rectifiers diffused junction

INTERNATIONAL RECTIFIER CORP., 1521 E. Grand Ave., El Segundo, Calif. Two new series of 6 and 12

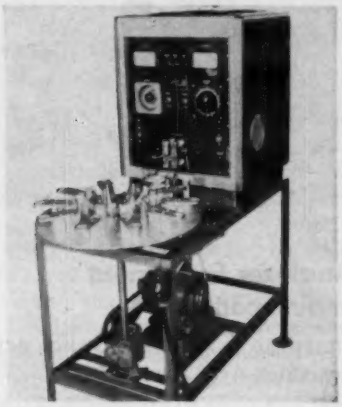
ampere rated silicon diffused junction rectifiers, designed specifically to meet rigid military specifications, are capable of operating to base temperatures of 190 C. The 6 amp series is designated JEDEC types 1N1341 through 1N1347, and the 12 amp series 1N1199 through 1N1205. Both have piv ranges from 50 to 500 v. All are manufactured by precision-controlled diffusion processes, assuring extremely low forward voltage drop, low leakage, and high uniformity of characteristics over the entire operating temperature range. Each diode is nickel-plated to provide minimum contact resistance and prevent corrosion. A flattened-pierced end on the top (anode) lead assures fast, easy wiring into production assemblies.

CIRCLE 419 ON READER SERVICE CARD

Precision Winder high-speed

ASSOCIATED AMERICAN WINDING MACHINERY, INC., 750 St. Ann's Ave., New York 56, N. Y., has added to its ME-301 electrical traverse "No-Dwel" winding machine an accessory for perfect thread layer winding. Within the range of wire sizes 0.025 in. through 0.065 in. (No. 22-No. 14 Awg) perfect winding has been accomplished. Work is continuing to expand the wire range.

CIRCLE 420 ON READER SERVICE CARD



Turntable continuously moving

MCDOWELL ELECTRONICS, INC., 105 Forrest St., Metuchen, N. J. To

Antenna dependability...

The plucky boxing shrimp rears up at its enemy and strikes out with strong pinchers to defend itself with all the strength of its inch-long body. It depends on long sensitive antennas to sense the approach of food . . . and warn of impending danger.

Antennas by D & M are even more sensitive and dependable. Modern aircraft and missiles rely upon D & M RF Systems and antennas in the detection of foreign signals . . . in relaying the information back to earth . . . in listening for commands from earth, and in changing flight patterns upon signal.

D & M with a generation of experience in building antennas for special uses, brings to your antenna problem a wealth of background information. Often we have been able to save precious time and good money by modifying an existing antenna design to do the job at hand.

If you are interested in solving your antenna problems quickly . . . and completely, talk them over with D & M.

Send for the new Antenna Catalog

The Boxing Shrimp uses its enlarged forearms for sparring off its predators.

dm

Excellent positions in a growing organization affording opportunities for stock participation, as well as many other benefits, are offered to engineers. Contact R. E. Anderson, Chief Engineer.

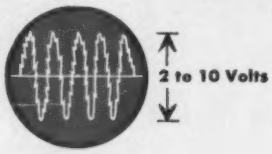
DORNE & MARGOLIN, Inc.

WEST COAST: 1434 Westwood Boulevard, Los Angeles 24, California

EAST COAST: 29 New York Avenue, Westbury, L. I., N. Y.

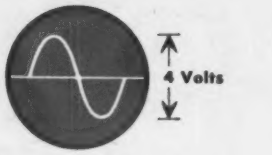
from Honeywell... ANOTHER DIAMOND JUBILEE PRODUCT

WHEN YOU HAVE
extraneous common mode signals



AND WANT TO MEASURE
0.1 to 100 millivolts full scale

AND THEN AMPLIFY



CHOOSE THE NEW HONEYWELL D-C AMPLIFIER

AccuData II

wide-band differential all-transistor D-C Amplifier for strain gages and thermocouples

- **Full Scale Input:** Unbalanced: ±100 μv to ±100 mv; Differential: ±3 mv to ±100 mv; Open Loop: Below drift level
- **Full Scale Output:** ±2v at 50 ma, dc to 10 kc
- **Frequency Response:** to 20 kc
- **Output Impedance:** Less than 0.5 ohm at dc on all ranges
- **Input Impedance:** Unbalanced 3 to 100 mv ranges; greater than 20 megohms in parallel with 350 micromicrofarads. Differential: Greater than ± 2 megohms
- **Equivalent D-C Input Drift:** Less than 2 μv/10°F ambient temp change on 0.1 to 30 mv input ranges
- **Equivalent Input Noise:** 4μv peak-to-peak on 100 μv to 300 μv range (0-10 cps). 8μv rms on 10 to 30 mv ranges (0 to 100 kc)
- **Common Mode Rejection:** 200,000 at 60 cps on 3 to 30mv ranges

The new Honeywell AccuData II is a completely transistorized D-C Amplifier designed for use in high accuracy data handling systems as a wide-band pre-amplifier for strain gages and thermocouples. Its output can be fed to electronic or electromechanical analog-to-digital converters and simultaneously recorded on galvanometer oscillographs or magnetic tape. Either differential or single-ended input modes can be selected by an eleven position range switch. This switch changes the gain in three-to-one steps. Intermediate gains with high resolution are provided by a ten-turn potentiometer Write for AccuData II Bulletin to Minneapolis-Honeywell, Dept. E-7, Boston Division, 40 Life Street, Boston 35, Mass.

Honeywell

First in Control

SINCE 1885

meet the growing demands for automation in connection with the use of its induction heating generators, the company has developed an economical continuously moving turntable. Speed is adjustable. The copper holder moving into the high impedance field acts as a combination low impedance transformer secondary coil and a work coil. There is no direct connection to the turntable for either r-f current or cooling water. The equipment may be used with any of the company's generators up to and including 10 Kw for soldering, brazing or making glass to glass seals.

CIRCLE 421 ON READER SERVICE CARD

Potentiometers all metal

KINTRONIC DIVISION of Chicago Aerial Industries, 1980 Hawthorne Ave., Melrose Park, Ill. The 500 series precision pots are of all metal construction, with glass to metal terminals, operating up to 105 C with a million life cycle. Applications include use in computers, servo loop systems and standard industrial applications where high operating temperatures are not of prime importance.

CIRCLE 422 ON READER SERVICE CARD

Analyzer Equipment automatic

MUIRHEAD INSTRUMENTS, INC., 441 Lexington Ave., New York 17, N. Y. This new automatic analyzer equipment fills a need in the field of large scale vibration and noise testing programs. It eliminates necessity for tedious, costly and time consuming manual analyses. With the

D-940-A two types of analysis are possible: amplitude/frequency analyses of steady signals and amplitude/frequency/time analyses of non-steady signals. Results are plotted on the D-976-A analyzer recorder operating either as an X/Y or X/time recorder. Frequency range of 10 cps to 19 Kc is covered in four bands and any one or series of these can be selected for automatic scanning. A choice of three bandwidths, 1.5 percent, 5 percent and 1/3 octave, is also available. Price of the complete rack mounted equipment is $12,500.

CIRCLE 423 ON READER SERVICE CARD

Mesa Transistors diffused silicon

INDUSTRO TRANSISTOR CORP., 35-10 36th Ave., Long Island City 6, N. Y. Type 2N696 and 2N697 diffused silicon mesa transistors are packaged in the TO-5 case for automatic handling. They are for medium power, small-signal amplifier and switching applications. Collector to emitter voltage for both types is 40 v, and collector power dissipation at 25 C is 2 w. The 2N696 has a d-c current gain of 20-60, and the 2N697 a gain of 40-120. Small signal current gain is typical at 5 for both. Collector saturation resistance is 3.5 typical to 10 ohms maximum. They are manufactured to meet or exceed MIL-S-19500B.

CIRCLE 424 ON READER SERVICE CARD

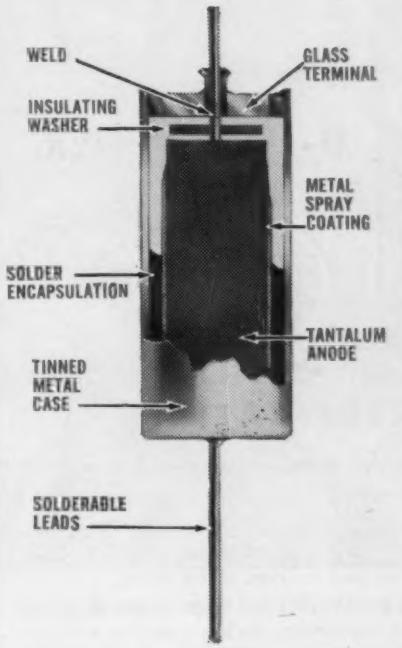
Inductor Kit for prototype work

CORNING GLASS WORKS, Electronic Components Dept., Bradford, Pa., has developed a kit of high stability glass inductors primarily for use in prototype work. An infinite variety of inductances between 0.05 and 2 μh is made possible by the kit's tuning cores. Kit includes 10 inductors, 4 tuning cores and a 50-page technical brochure. Corning inductors have a consistently low temperature coefficient of inductance over their operating temperature range of −55 C to 125 C. It is from zero to +20 ppm/deg C, without cores. Q factor ranges

ASTRON SOLID TANTALUM CAPACITORS FEATURE

NO. 4 OF A SERIES

reliability



Quality control to military standards under rigid testing conditions provides reliability for extreme environmental conditions.

Astron solid tantalum capacitor production is regularly tested in accordance with MIL-STD-202A and other test standards.

A complete line of capacitors is available which meet the requirements of MIL-C-21720 (Navy) and MIL-C-55057 (Sig. C.).

- Rugged construction withstands the strain of 200 g acceleration and 150 g shock tests.
- Operation from −80°C. to +125°C.
- Solid electrolyte cannot leak, even if the seal is broken.
- Subminiature size answers increasing needs for small, light weight electronic components.
- Wide variety of applications exists in missiles and aircraft and transistorized equipment of all types.

FOR COMPLETE INFORMATION WRITE TODAY FOR BULLETIN E-675A AND FOR ASTRON'S DESIGN ENGINEER PUBLICATION, TECHNIQUES VOL. 59, NO. 2

ASTRON CORPORATION

See us at IRE Booth #2602

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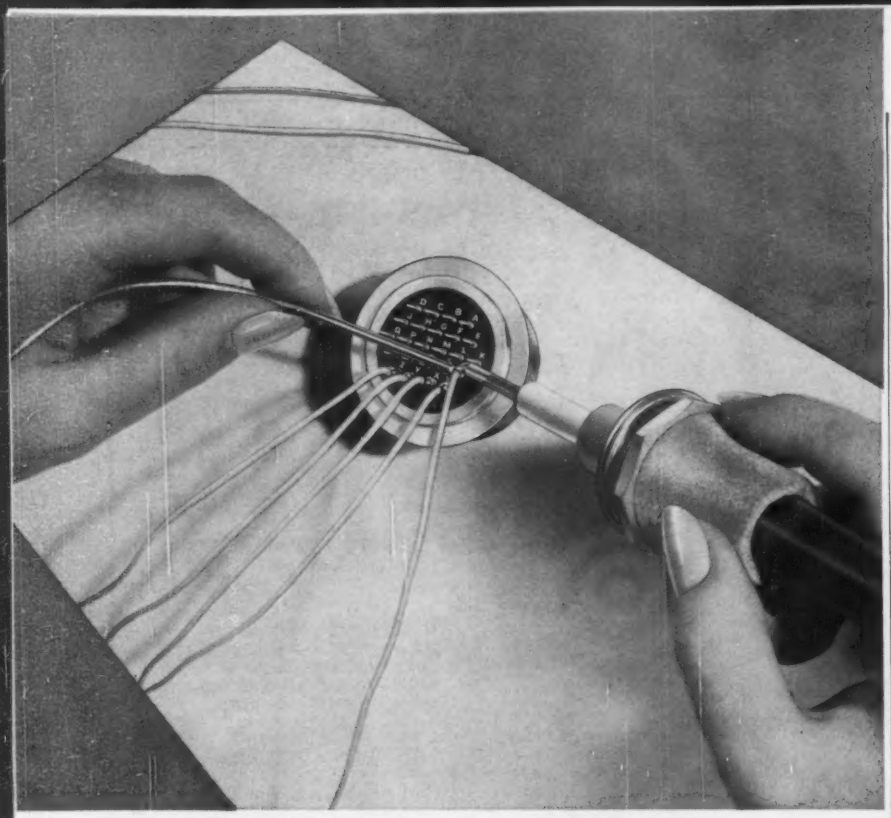
East Newark, New Jersey

SPECIALISTS IN CAPACITOR MINIATURIZATION



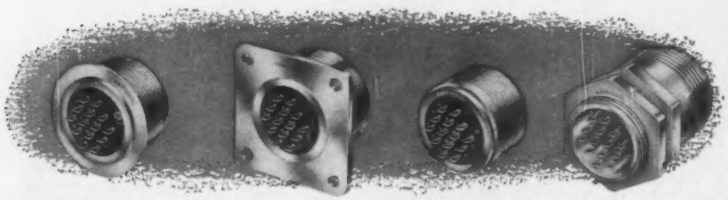
Instant **CONTACT IDENTIFICATION**

Identoseal **SEAL**
HERMETIC RECEPTACLES

Faster wiring, less chance of errors, reduced inspection time—these production advantages are possible only with AMPHENOL's superior Identoseals. Each contact is clearly and sharply defined—fired-on white ceramic letters contrasting strongly with the dark brown glass—both on the face and the rear of the insert.

Instant contact identification is one of many advantages of AMPHENOL Identoseals. Rugged *compression* sealing provides a tight bond between shell, glass and contacts that is extremely strong and highly resistant to thermal shock. Identoseals are capable of continuous operation at 850° F. Insulation resistance is over 100,000 megohms.

Identoseals are available in MS-type receptacles that mate with MIL-C-5015 plugs, in miniature sizes and in numerous special configurations. An engineering staff experienced in hermetic sealing can immediately meet your requirements.

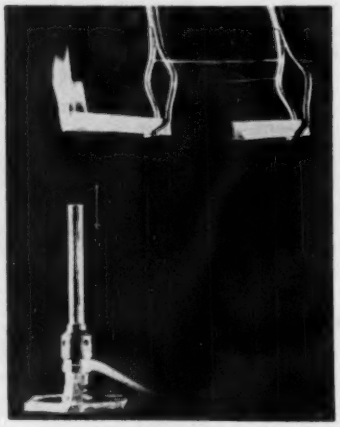


"MS" Round Flange *"MS" Square Flange* *"MS" Flangeless* *"MS" Hex. Flange*

AMPHENOL **CONNECTOR DIVISION**
Amphenol-Borg Electronics Corporation
1830 S. 54TH AVENUE • CHICAGO 50, ILLINOIS

from 120 to 200, depending on inductance value and frequency. Maximum d-c current capacity is over 1 ampere for all values. Tolerance is ±10 percent.

CIRCLE 425 ON READER SERVICE CARD



Flexible Epoxy
flame retardant

HYSOL CORP., Olean, N. Y. Hysol 15-032 immediate flame-out flexible epoxy is non-burning by ASTM D635-56T standards, and self extinguishing according to MIL-T-27 ASTM tests. It is now available for imbedding electrical-electronic components.

CIRCLE 426 ON READER SERVICE CARD

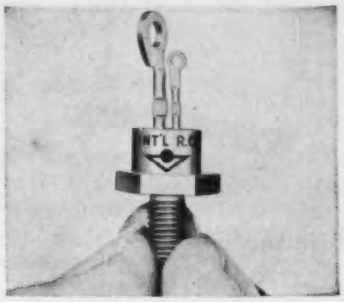
Pulse Generator
high speed

RUTHERFORD ELECTRONICS Co., 8944 Lindblade St., Culver City, Calif. Model B-5A's pulse repetition rates are continuously variable from 1 cps to 10 Mc in seven ranges and it features a rise and fall time of less than 8 mμsec. It has an electronic pulse delay that can be set

to zero or is continuously variable from 0.030 μsec to 500 μsec in five ranges. Pulse width is continuously variable from 0.02 to 12.5 μsec in four ranges.

CIRCLE 427 ON READER SERVICE CARD

Other Products



Controlled Rectifier
16 ampere rated

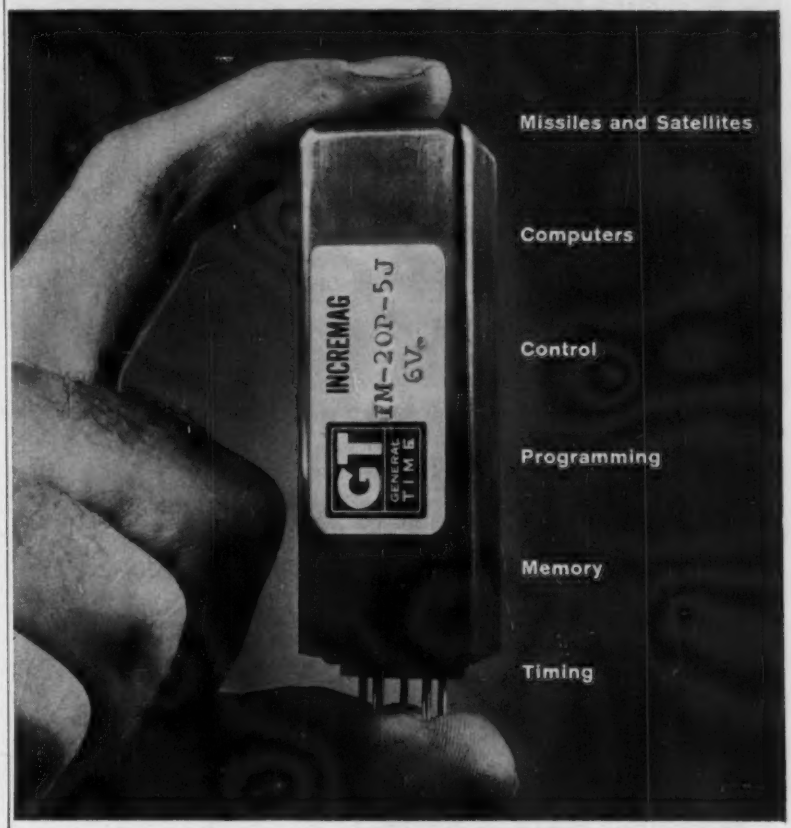
INTERNATIONAL RECTIFIER CORP., 1521 E. Grand Ave., El Segundo, Calif. Types X16RC2 through X16-RC20 "Thyrode" silicon controlled rectifiers are for applications requiring load currents up to 16 amperes and blocking voltages from 20 to 200 v. Units are capable of controlling 16 amperes of current on such applications as static switching, d-c motor control, variable and regulated d-c power supplies, welding control, ignitron firing and similar switching uses. The three-junction unit will switch rapidly to a conducting state either when a signal is applied to its third (gate) terminal, or when its critical breakover voltage is exceeded. Thus it can perform many of the functions of the magnetic amplifier, thyratron, power transistor and related units. The hermetically sealed units have an overall height of 1.615 in. maximum.

CIRCLE 428 ON READER SERVICE CARD

Fluxing Additive
acts as adhesive

WESTINGHOUSE ELECTRIC CORP., P. O. Box 2099, Pittsburgh 30, Pa., has available a fluxing additive that acts as an adhesive to keep the flux close to the base metal. Wes-X501 eliminates the critical time between

INCREMAG® components and systems for more accurate requirements



GENERAL SPECIFICATIONS

COUNTING RATE: up to 100,000 pps max.
TEMPERATURE RANGE: −55°C to +125°C
COUNT PER STAGE: up to 16 max. in ½ cubic inch
NUMBER OF STAGES: as required
VOLTAGE TOLERANCE: ±10% most cases

See demonstration at Booth 1726A,
IRE Radio Engineering Show, New York City, March 21-24

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Electronic Products and Systems

CIRCLE 249 ON READER SERVICE CARD

NEW BOESCH MAXITOR

winds toroids from #40 to #7 wire . . . using 3 interchangeable heads

Boesch's new MAXITOR Toroidal Coil Winding Machine covers a wide range of applications, including exceptionally large diameter, heavy wire gauge winding jobs. The coil shown above is typical. It is being wound with #10 wire on a MAXITOR machine using Boesch's HW-200 winding head and continuous-winding core holder. Segmental-winding holder is also available.

Two other interchangeable heads are available which make MAXITOR a really versatile machine. The HW-300 head winds wire gauges as large as #7 to finished O.D. as much as 14". HW-100 handles gauges from #40 to #22 to maximum O.D.'s of 10".

And MAXITOR is packed with "dream" features. Pushbutton drive ring and magazine positioning saves set up time. A dial control on the operator's panel provides micrometer brake settings for easiest variable speed tension control. Turn spacing is infinitely variable at the turn of a knob. And the range of winding applications for MAXITOR is apparent in the table below.

Head Type	Min. Final I.D.	Max. Final O.D.	Max. Final Height	Wire Range AWG #
HW-100	½"	10"	6"	40 to 22
HW-200	1"	10"	6"	24 to 10
HW-300	2"	14"	10"	20 to 7

WRITE TODAY for complete specifications, prices and delivery information.

BOESCH MANUFACTURING COMPANY, INCORPORATED
DANBURY, CONNECTICUT

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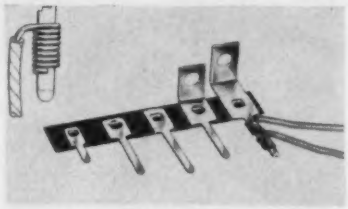
fluxing and hot dipping. In fact, parts have been flux dipped, allowed to dry, then hot dipped three weeks later with excellent results. The flux additive has reduced the number of rejected or reworked parts and makes hot dipping of cast parts easier. The additive can be used in any aqueous flux bath.

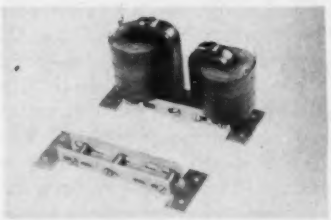
CIRCLE 429 ON READER SERVICE CARD



Terminals "Wrap-A-Wire" type

MALCO MFG. CO., 4025 W. Lake St., Chicago 24, Ill. "Wrap-A-Wire" terminals reduce labor costs and speed production of electrical/electronic assemblies, connectors for coil forms, p-c boards, etc. They are easily inserted and fastened, and the single square lug prevents turning. Each terminal can take one or more wire leads using wire wrap methods. Reliable wrapped connections hold securely and help to simplify and reduce assembly time.

CIRCLE 430 ON READER SERVICE CARD



Core Mounting standardized

COREMOUNT, 704 W. Slauson Ave., Los Angeles 44, Calif. Designed to simplify, by standardization, the mounting of cores in any application, Coremount will accommodate 1600 different U and E core sizes. There are 42 different strip widths available in various adjustable lengths. Coremount is a complete unit, made from steel or aluminum, employing unique single-piece con-

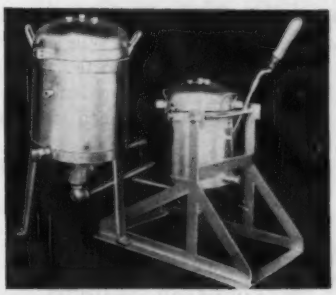
struction, and supplied with all the hardware necessary for mounting. A simple adjusting feature assures the precise fit of all core sizes.

CIRCLE 431 ON READER SERVICE CARD

D-C Amplifier differential type

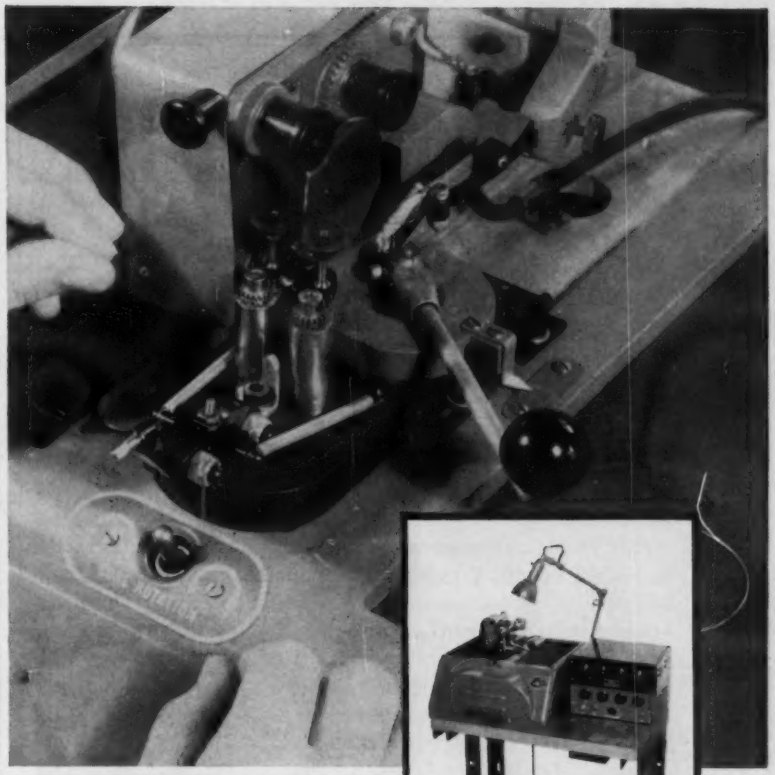
NEFF INSTRUMENT CORP., 2211 E. Foothill Blvd., Pasadena, Calif., offers a transistorized differential d-c amplifier, featuring a true floating input and stability of 0.05 percent. In the type 1-102 ground loop or circulating current problems in data processing systems have been eliminated through a unique transformer isolation design. The amplifier operates with both input and output isolated from each other and from ground. Thus, strain gage and thermocouple data, or data traveling over long signal lines, cannot be destroyed through accidental voltage drops. Heart of the unit is a maintenance-free shielded input module which guarantees high common-mode rejection (100 million to 1). Gain is variable in steps of 10, 20, 30, 50, 100, 200, 300 and 500.

CIRCLE 432 ON READER SERVICE CARD



Laboratory Furnace gas-fired

MATERIALS FOR ELECTRONICS, INC., 152-25 138th Ave., Jamaica 34, N. Y., has available Degussit's Lilliput gas-fired furnace. Unit, in its standard design, permits annealing, sintering and smelting at tempera-



NEW BOESCH MINITOR

. . . machine-winds 1/32" toroids

The coil shown above is a 1/32" residual I.D. toroid being wound *by machine* on Boesch's new Model MW400 MINITOR. It's the smallest machine-wound coil ever made (only half as large as the smallest previously available), and it can only be wound on MINITOR!

This achievement reflects a completely new, unique method of coil winding perfected by Boesch. The wire is loaded *inside* a hollow, round cross-section shuttle, and the winding is spun out. A single loading of this unique shuttle is usually enough to wind several coils.

MINITOR handles wire sizes from #36 to #50 AWG, and winds up to 500 turns per minute. Maximum finished coil size is ¾".

Shuttles for MINITOR are loaded by a Boesch PW-100 Loader. This machine can service as many as 20 winding machines, and it can load needles for hand winding as well.

If you now own a Boesch SM series machine, you can convert it to MINITOR operation economically by buying a 400-200 Head, a 400-300 Core Rotating Assembly, and the PW-100 Loader.

WRITE TO US TODAY for complete specifications, delivery schedules and prices on MINITOR.

BOESCH MANUFACTURING COMPANY, INCORPORATED
DANBURY, CONNECTICUT

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CIRCLE 251 ON READER SERVICE CARD

2 SENIOR SCIENTISTS

Here's news of outstanding opportunities for two senior scientists attending the IRE Convention!

1. THEORETICAL PHYSICIST

Immediate opening for a Special Assistant to the Director of Melpar's Advanced Development Staff, located in Falls Church, Virginia. Responsible for undertaking independent research assignments and coordinating with other groups in formulating new techniques, devices, and systems. Applicants should have Phd in physics, plus five to 10 years' experience in such fields as acoustics, IR, and optics. Particular strength in electromagnetic wave theory is highly desirable.

2. INFORMATION THEORY SPECIALIST

Melpar's Applied Science Division—located in the Boston area—is now conducting basic research programs and studies of phase-coherent, anti-multipath correlation systems, matched filters, ambiguity analysis, waveform analysis, and signal coding. Melpar's Applied Science Division facilitates and encourages independent research. Applicants should have MS or Phd degree, with competence in statistical theories of communications, information theory, or decision theory, with experience in basic or applied research in communications theory, artificial intelligence, and pattern recognition.

For personal interview
during IRE Convention
Call Mr. DAVID C. TROTT
Melpar Suite—Waldorf-Astoria Hotel

Or write to:
Professional Employment Supervisor

MELPAR, INC.

A Subsidiary of Westinghouse Air Brake Company
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In Historic Fairfax County • 10 miles from Washington, D. C.

tures up to 1,800 C (3,272 F). It is supplied in stationary and tiltable models. For special purposes, the furnace can be provided with a special brick lining permitting its operation at higher temperatures. By the addition of small amounts of oxygen to the air, or by the use of hydrogen instead of gas, temperatures of 2,000 C (3,632 F) and higher, can be obtained. The furnace features simple construction, small space requirement and relatively large capacity (120 cm³).

CIRCLE 433 ON READER SERVICE CARD

Coax Attenuator d-c to 7,000 Mc

RADAR DESIGN CORP., 1002 Pickard Drive, Syracuse 11, N. Y. The RDA-1 series, with attenuation values of 3, 6, 15 and 20 db has been redesigned to hold low vswr (1.25 maximum) and frequency sensitivity of 0.05 db/db maximum through 7,000 Mc. With a maximum overall length of 3 in., the units utilize mounted type N connectors, and incorporate permanent, non-aging precious metal resistors evaporated onto rugged mica bases.

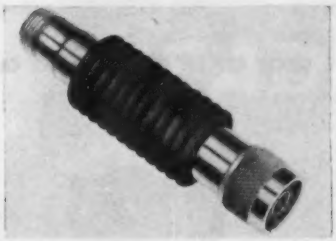
CIRCLE 434 ON READER SERVICE CARD

Automatic Equipment for checkout systems

EPSCO, INC., 275 Massachusetts Ave., Cambridge 39, Mass., announces four new automatic checkout equipments—an rms to d-c converter, a voltage-to-digital converter, a timer-counter and a digital printer. These completely militarized units, designed to meet the rigid environmental requirements

of MIL-E-4158B, are in use today in a missile automatic checkout system that measures d-c voltages, a-c voltages, and the transient responses of servos which control time, frequency, ratio, thrust, roll, pitch and yaw.

CIRCLE 435 ON READER SERVICE CARD



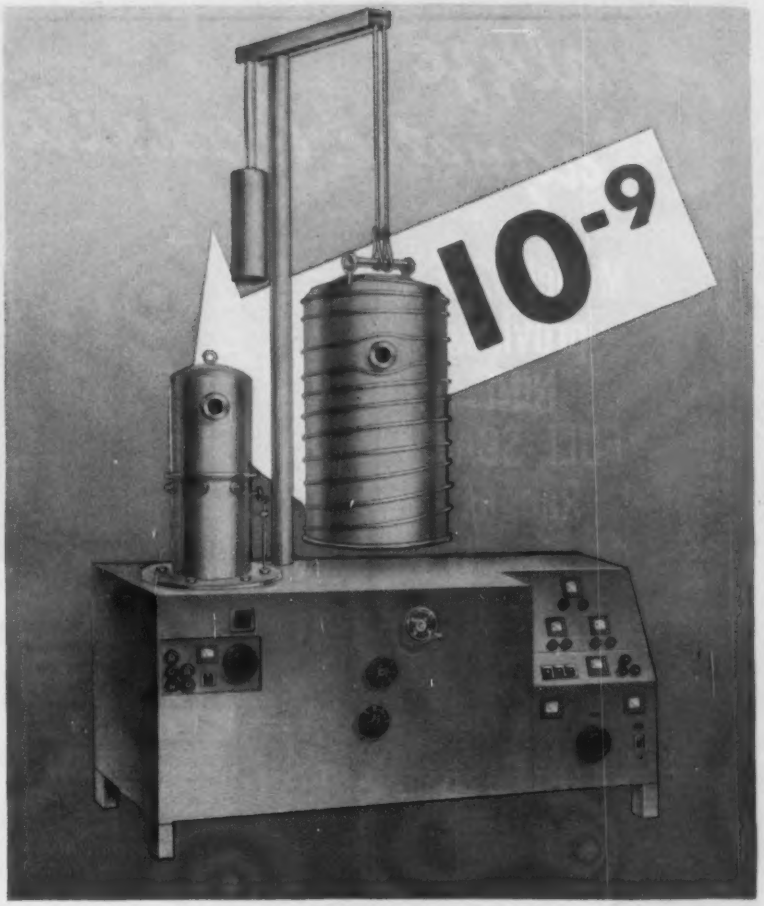
Coax Attenuator for high power

MICROLAB, 570 West Mt. Pleasant Ave., Livingston, N. J. The AD series coaxial microwave attenuators, with an input power rating of 15 w, operate from d-c to 4,000 Mc. They consist of two or more tee section pads properly cascaded to distribute the power dissipation. Cooling fins are provided to minimize temperature rise. Deposited carbon film resistors on ceramic forms are used to permit a high surface temperature with long-term stability as well as resistance to shock, moisture, etc. The attenuators are supplied from stock with N, BNC, TNC, C or HN connectors at values of 3, 6, 10, 20, 30 and 40 db. Maximum vswr is 1.20.

CIRCLE 436 ON READER SERVICE CARD

Static Inverter small and light

WESTAMP INC., 11277 Massachusetts Ave., Los Angeles 25, Calif., has developed a static inverter that changes d-c to a square wave a-c which will drive motors directly without the need of an output



Kinney®

UH-9 ULTRA HIGH VACUUM SYSTEM for Work in the 10^{-9} mm Hg Range

A most significant advance in High Vacuum Technology, which brings yesterday's theoretical pressures to you in a practical working tool! The KINNEY UH-9, employing differential Pumping, gives you 1 x 10^{-9} mm Hg or better, enabling you to arrive at determinations that were, heretofore, unattainable. Write for full information today.

IN OPERATION AT THE KINNEY BOOTH 4309-11 I. R. E. SHOW MARCH 21-24 N. Y. COLISEUM

KINNEY VACUUM DIVISION
THE NEW YORK AIR BRAKE COMPANY
3565C WASHINGTON STREET • BOSTON 30 • MASS.

Please send me full information on KINNEY UH-9 Ultra High Vacuum System.

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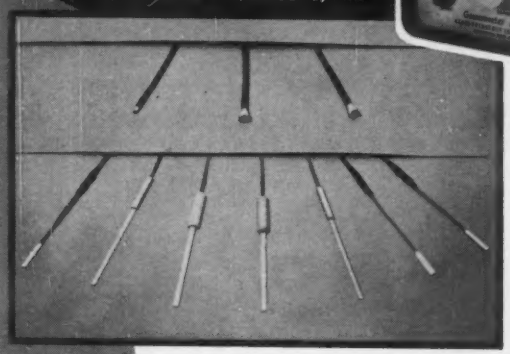
CIRCLE 253 ON READER SERVICE CARD

Analyze Magnetic Circuits

Model 1295A provides NINE FULL-SCALE Ranges

(0 — 20K+ Gausses)



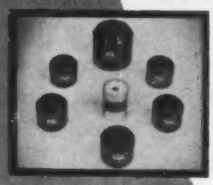
This Gaussmeter employs temperature stabilizing transistor circuits and a full set of balancing controls for fine adjustment. Readings are accurate to ±3%, repeatable within 1%; accuracy can be increased to ±1% at most points using special reference magnets. Magnetic fields from DC to 400 cps can be measured.

Ten Probes Fit Most Magnet Gaps

Each of the probes shown will work from 0 to 20K+ gausses with the Model 1295A. Since no single probe will fit all magnet configurations, a selection of Bi and InAs elements, rigid or flexible shafts, and flat or axial tips varying from .010" to 0.312" thick is available to meet most applications.

With the Model 1295A and any probe, it's easy to make direct measurements of gap flux density; analyze location, homogeneity, direction and intensity of stray fields in magnetic circuits. Formula predictions can be checked by direct measurement.

Probe Reference Magnets



The 1000-gauss ±¾% flat probe ref. magnet supplied with the Model 1295A is sufficient to maintain the ±3% system accuracy over all ranges. Other values from 200 to 10K gausses, including axial fields, are also available. All magnets are properly stabilized and shielded.

Net price of Model 1295A with reference magnet (without probe) is $390. f.o.b. Boonton, N.J. Probes from $30. to $180.

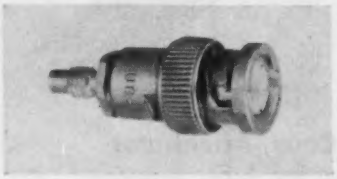
SEND FOR TECH. DATA

For additional information, including application data, write or phone DE 4-3100. Demonstrations available by local representatives.

RFL Radio Frequency LABORATORIES, INC. Boonton, New Jersey, U. S. A.

transformer. Although weighing only 3 oz with a total volume of just over 2½ cu in., model P303 is capable of supplying 60 w of power at an efficiency of over 90 percent. A frequency stability of ±1 percent over a wide temperature range makes this unit ideal for the operation of gyro and recorder motors. Basic unit operates from 28 v d-c with an output frequency of 400 cycles.

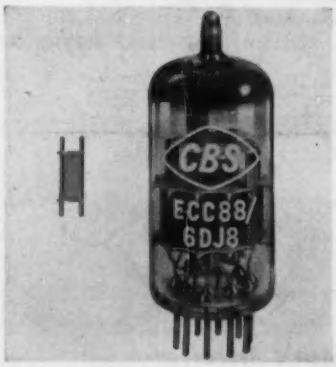
CIRCLE 437 ON READER SERVICE CARD



Cable Adapter
variety of uses

SEALECTRO CORP., 139 Hoyt St., Mamaroneck, N. Y. New 50 ohm BNC adapter will accept all series 3000 ConheX r-f subminiature connectors. It will accommodate all 50 ohm ConheX connectors to BNC panel fittings. The adapter also permits the use of many of the new subminiature cables to existing larger cables and connectors used in ground control equipment, radar and test equipment.

CIRCLE 438 ON READER SERVICE CARD



Twin Triode
high-gain

CBS ELECTRONICS, 100 Endicott St., Danvers, Mass. The ECC88/6DJ8 high-gain twin triode with true frame-grid construction is now available. It offers high reliability

electronics READER SERVICE

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1	31	61	91	121	151	181	211	241	271	301	331	361	391	421	451	481	511	541	571
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3	33	63	93	123	153	183	213	243	273	303	333	363	393	423	453	483	513	543	573
4	34	64	94	124	154	184	214	244	274	304	334	364	394	424	454	484	514	544	574
5	35	65	95	125	155	185	215	245	275	305	335	365	395	425	455	485	515	545	575
6	36	66	96	126	156	186	216	246	276	306	336	366	396	426	456	486	516	546	576
7	37	67	97	127	157	187	217	247	277	307	337	367	397	427	457	487	517	547	577
8	38	68	98	128	158	188	218	248	278	308	338	368	398	428	458	488	518	548	578
9	39	69	99	129	159	189	219	249	279	309	339	369	399	429	459	489	519	549	579
10	40	70	100	130	160	190	220	250	280	310	340	370	400	430	460	490	520	550	580
11	41	71	101	131	161	191	221	251	281	311	341	371	401	431	461	491	521	551	581
12	42	72	102	132	162	192	222	252	282	312	342	372	402	432	462	492	522	552	582
13	43	73	103	133	163	193	223	253	283	313	343	373	403	433	463	493	523	553	583
14	44	74	104	134	164	194	224	254	284	314	344	374	404	434	464	494	524	554	584
15	45	75	105	135	165	195	225	255	285	315	345	375	405	435	465	495	525	555	585
16	46	76	106	136	166	196	226	256	286	316	346	376	406	436	466	496	526	556	586
17	47	77	107	137	167	197	227	257	287	317	347	377	407	437	467	497	527	557	587
18	48	78	108	138	168	198	228	258	288	318	348	378	408	438	468	498	528	558	588
19	49	79	109	139	169	199	229	259	289	319	349	379	409	439	469	499	529	559	589
20	50	80	110	140	170	200	230	260	290	320	350	380	410	440	470	500	530	560	590
21	51	81	111	141	171	201	231	261	291	321	351	381	411	441	471	501	531	561	591
22	52	82	112	142	172	202	232	262	292	322	352	382	412	442	472	502	532	562	592
23	53	83	113	143	173	203	233	263	293	323	353	383	413	443	473	503	533	563	593
24	54	84	114	144	174	204	234	264	294	324	354	384	414	444	474	504	534	564	594
25	55	85	115	145	175	205	235	265	295	325	355	385	415	445	475	505	535	565	595
26	56	86	116	146	176	206	236	266	296	326	356	386	416	446	476	506	536	566	596
27	57	87	117	147	177	207	237	267	297	327	357	387	417	447	477	507	537	567	597
28	58	88	118	148	178	208	238	268	298	328	358	388	418	448	478	508	538	568	598
29	59	89	119	149	179	209	239	269	299	329	359	389	419	449	479	509	539	569	599
30	60	90	120	150	180	210	240	270	300	330	360	390	420	450	480	510	540	570	600

INSIDE FRONT COVER — INSIDE BACK COVER

SEARCHLIGHT SECTION

651	653	655	657	659	661	663	665	667	669	671	673	675	677	679	681	683	685	687	689
652	654	656	658	660	662	664	666	668	670	672	674	676	678	680	682	684	686	688	690

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1	31	61	91	121	151	181	211	241	271	301	331	361	391	421	451	481	511	541	571
2	32	62	92	122	152	182	212	242	272	302	332	362	392	422	452	482	512	542	572
3	33	63	93	123	153	183	213	243	273	303	333	363	393	423	453	483	513	543	573
4	34	64	94	124	154	184	214	244	274	304	334	364	394	424	454	484	514	544	574
5	35	65	95	125	155	185	215	245	275	305	335	365	395	425	455	485	515	545	575
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INSIDE FRONT COVER — INSIDE BACK COVER

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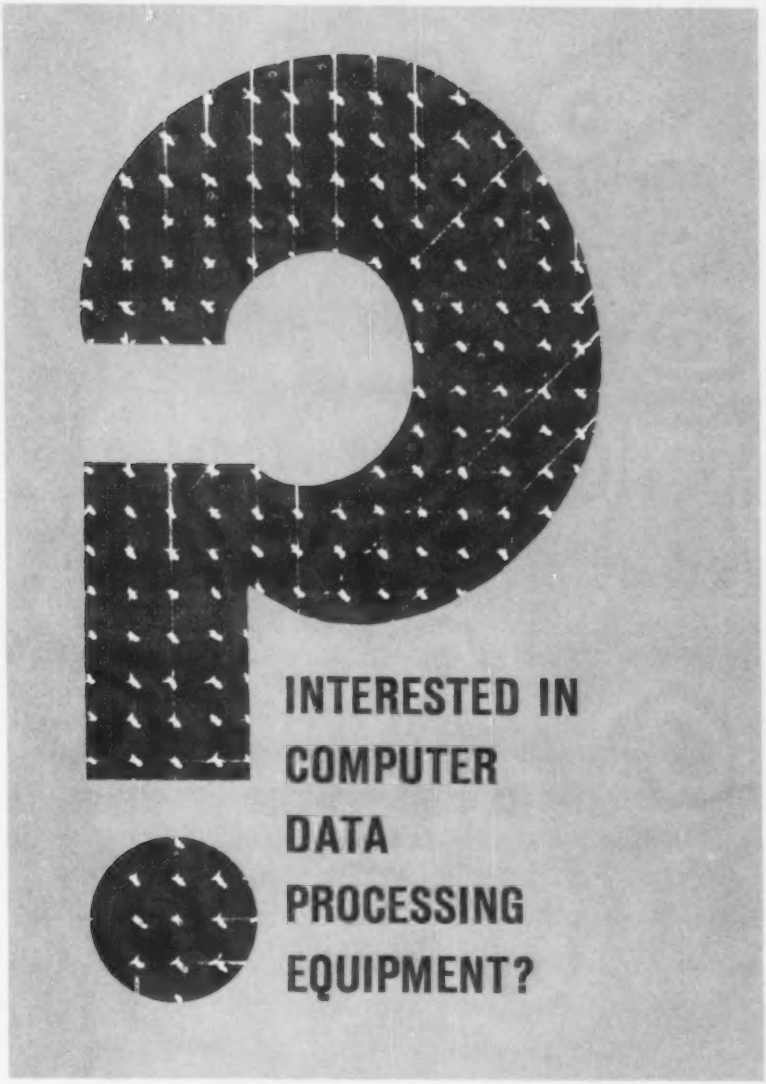

In the past several months, **electronics** has published articles on computers and data processing equipment ideas, future trends. Accurate **electronics** reporting tells you what's happening *now* in the field... what to expect *in the future.* That's how, on dozens of subjects, **electronics** helps make your research, development, sales and marketing plans pay off! Keep informed, subscribe to **electronics** (or renew) right now. Fill in box on Reader Service Card. Easy to use. Postage free.

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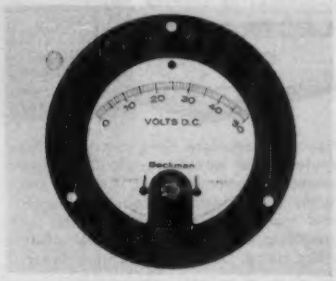
for instrumentation, industrial controls, nuclear electronics, communications and broadcast equipment and tv tuners. Tube provides high transconductance, high input impedance, low noise figure and uniform characteristics. Its grid operates cooler, and it features a trouble-free coil heater.

CIRCLE 439 ON READER SERVICE CARD

Power Unit
industrial

OPAD ELECTRIC CO., 43 Walker St., New York 13, N. Y. Housed for mounting on wall or machinery. Twelve models are available, operating from 115 or 230 v a-c. Outputs are 125 or 250 v d-c in ranges from 0.5 to 16 amperes. Units are self-cooled and operate, continuous duty, in ambient temperatures to 35 C. Average efficiency at full load is 68 percent.

CIRCLE 440 ON READER SERVICE CARD



Panel Meters
military style

HELIPOT DIVISION of Beckman Instruments, Inc., 2500 Fullerton Road, Fullerton, Calif., has available 2½ in. panel meters. Line features 61 standard models built in accordance with MIL-M-10304A, including voltmeters, ammeters, mi-

COMBINES LABORATORY PRECISION AND RANGE... WITH EASY PORTABILITY
NEW MOTOROLA ALL-PURPOSE TRANSISTORIZED AC VOLTMETER $165.00

Here is Motorola's quality-plus answer to the need for a compact, portable, moderately-priced AC voltmeter . . . with high input impedance, broad frequency response and built-in power source. The new Motorola AC volmeter measures audio, supersonic and low RF voltages. You'll find it ideal for design, production and field maintenance of electrical, electronic and electro-mechanical equipment.

Size: 5″ x 6″ x 10″, Weight: 5 lbs.

At the I.R.E. Show visit Booth 1115 and see how . . .

THESE FEATURES ADD UP TO OUTSTANDING PERFORMANCE

VOLTAGE RANGE	1 mv to 300 volts full scale (RMS) in 12 ranges . . . plus db scale range of −72 db to + 52 db.
ACCURACY	within ±3% of full scale between 20 cycles and 1 mc at nominal operating temperature.
INPUT IMPEDANCE	10 megohms shunted by 15 mmf on 1—300 volt ranges; 1 megohm shunted by 30 mmf on 1—300 mv ranges.
OVERLOAD PROTECTION	up to 550 volts in "volt" ranges; up to 110 volts (AC) in "millivolt" ranges.
ALL TRANSISTOR CIRCUIT	instant operation without warmup . . . minimum maintenance and recalibration.
BATTERY	6.5 volt battery powers unit over 400 hours—for operation cost of less than half-cent per hour.

Model also available with protective front cover—cable kit optional.

WRITE FOR LITERATURE WITH FULL PERFORMANCE SPECIFICATIONS

MOTOROLA *AC VOLTMETER*

Motorola Communications & Electronics, Inc., 4501 Augusta Blvd., Chicago 51, Ill.
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SENSITIVE RESEARCH
.01% ACCURATE
.005% STABLE

MODEL STV

D.C. VOLTAGE STANDARD

The Model STV is an extremely accurate and stable reference source for use with "null balance" devices such as potentiometers and other infinite impedance comparators. It is at least equivalent in accuracy to the best unsaturated standard cells and is superior in almost all other respects to both saturated and unsaturated types.

While the Model STV is essentially a zero current drain source, it can be operated into any impedance without damage. It can be short circuited indefinitely without affecting accuracy or life expectancy and it will almost instantaneously regain its original open circuit voltage when the short is removed. Vibration from transportation, exposure to extremes of temperature, and operating position do not affect its accuracy.

Specifications — Type "A"

Input: 90-135 v.; 60 cps; 25 va.

Output: 1.0000 v. and 1.0185 v.

Accuracy: ± .01% of nominal listed output (certificate furnished to .001% of actual output).

Stability: ± .005% of actual output, for 100-125 v. input and 20° – 30°C.; .01% for 90-140 v. input and 15° – 35°C.

Temp. Range: 15°C – 35°C (operates with reduced accuracy beyond these limits, but with its voltage exactly reproducible).

Operational Life: 25,000 hours minimum.

Size: 9⅛" x 7⅛" x 5". **Weight:** 10 lbs.

The Model STV is available for 19" rack panel mounting and in 3½" x 3" x 3" cans for OEM users (input must be regulated to 1%). Write for additional information on all types and special versions.

SENSITIVE RESEARCH INSTRUMENT CORPORATION
NEW ROCHELLE, N. Y.

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ELECTRICAL INSTRUMENTS OF PRECISION SINCE 1927

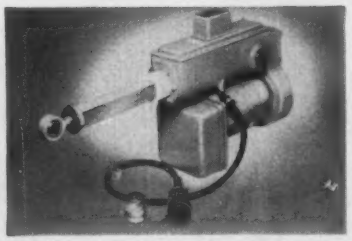
croammeters and milliammeters. Accuracies of 2 percent full scale value on d-c models and 3 percent full scale value on a-c rectifier types are standard. A wide range of special modifications are readily available on any meter.

CIRCLE 441 ON READER SERVICE CARD

UHF Preamplifier low noise

COMMUNITY ENGINEERING CORP., P. O. Box 824, State College, Pa. Designed for use in the 250-500 Mc range, model 1002 has a gain of 20 db with noise figures of better than 5 db at 250 Mc, 6 db at 500 Mc. Unit is fixed tuned to required frequency with a bandwidth of 10 Mc. It employs two GE7077 ceramic planar triodes in a two-stage grounded-grid amplifier. Tubes are mounted as an integral part of a silver plated coaxial type cavity resonator, to increase operating efficiency, reduce losses and permit a more compact package. Screw driver adjustments are provided for independent tuning of cavities. Price is about $395.

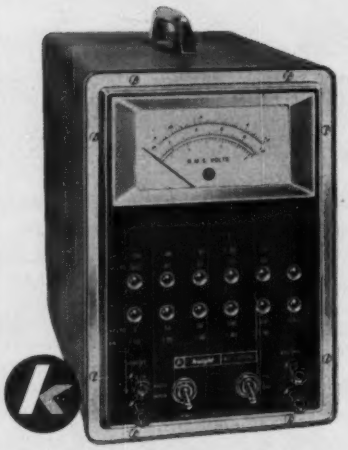
CIRCLE 442 ON READER SERVICE CARD



Linear Actuator open-loop positioning

LEAR, INC., Grand Rapids, Mich. Model 499B actuator can move three-quarters of a ton and hold a ton-and-a-half. A brake is used to reduce overcoast to a minimum. Stroke of the actuator is continuously adjustable from 4.25 to 5.25

← **CIRCLE 258 ON READER SERVICE CARD**



This is the new ***knight-kit*** **ac vtvm.** It marks a major achievement in instrumentation... and a break-through in the professional instrument price barrier. Here is the only vtvm with **automatic range selection**... featuring a self-seeking mechanism which automatically selects the proper range when probes are touched to the circuit under examination. Simultaneously, a front panel light indicates the range in use. There are 11 ranges from 3 millivolts to 300 volts full scale; frequency response to 2.5 mc. Reads as low as 100 μv. This precision instrument is an exclusive ***knight-kit*** development, designed for easy assembly. There is nothing like it on the market, in any form or at any price. Available only from Allied Radio.....**$99.50**

only $5.00 down

Ask for detailed specification sheet covering the new Knight-Kit AC VTVM

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See the complete Knight-Kit line for professional and home use. Includes scores of instrument, hi-fi, Amateur and hobbyist kits—best by design—the most for your money. For everything in Kits, for everything in Electronics, get the Allied 1960 Catalog. Send for FREE copy today.

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☐ Send Free 1960 Allied Catalog No. 190A.

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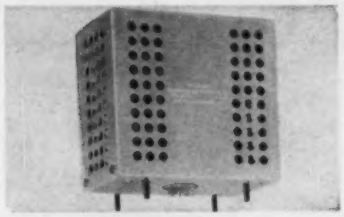
in. The unit is powered by a single-phase 115-v 60-cps motor capable of developing 0.14 h-p at 5,000 rpm. The actuator is packaged in a 16-lb envelope. Being self-contained, it needs no auxiliary equipment for control as do hydraulic or pneumatic actuators. Model 499B-1, with shorter stroke of 2.75 to 3.75 in., is also available.

CIRCLE 443 ON READER SERVICE CARD



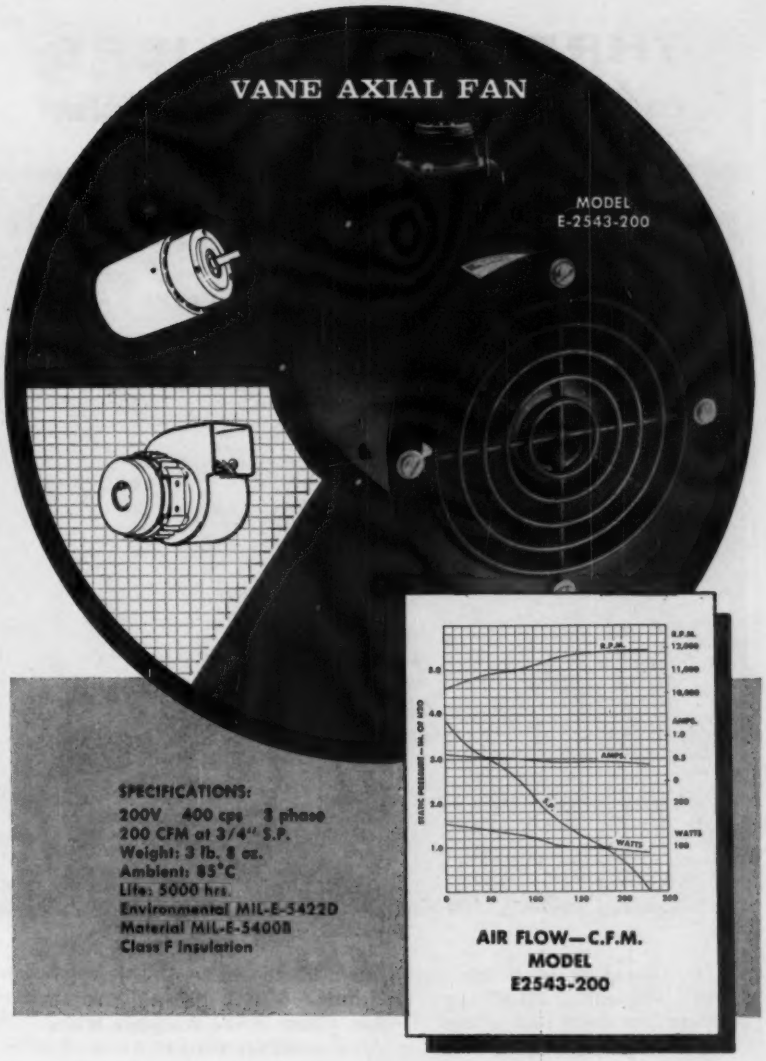
Power Supply programmable

HARRISON LABORATORIES, INC., 45 Industrial Road, Berkeley Heights, N. J. Model 850 highly regulated transistor power supply is adjustable from 0 to 15v at any output current from 0 to 1 ampere. An octal plug is used for all input and output connections to the supply, including remote programming (333 ohms/v) and remote sensing. Regulation is better than 3 mv; ripple, less than 500 μv for any combination of line or load. No voltage overshoot can occur at turn-off, and supply is fully protected for all overload conditions including a direct short across the output (no fuses employed). Unit measures 6½ in. long, 3 7/16 in. wide, 6 in. high. Price is $197.

CIRCLE 444 ON READER SERVICE CARD

Silicon Transistor high voltage

FAIRCHILD SEMICONDUCTOR CORP., 545 Whisman Road, Mountain View, Calif., announces the 2N698 high voltage diffused silicon transistor. The 120 v collector to base rating allows wider voltage swings in amplifier and oscillator circuits plus more protection in inductive switching circuits. Maximum base saturation voltage is 1.3 v. Typical gain-bandwidth product of 90 Mc assures excellent vhf and broad-



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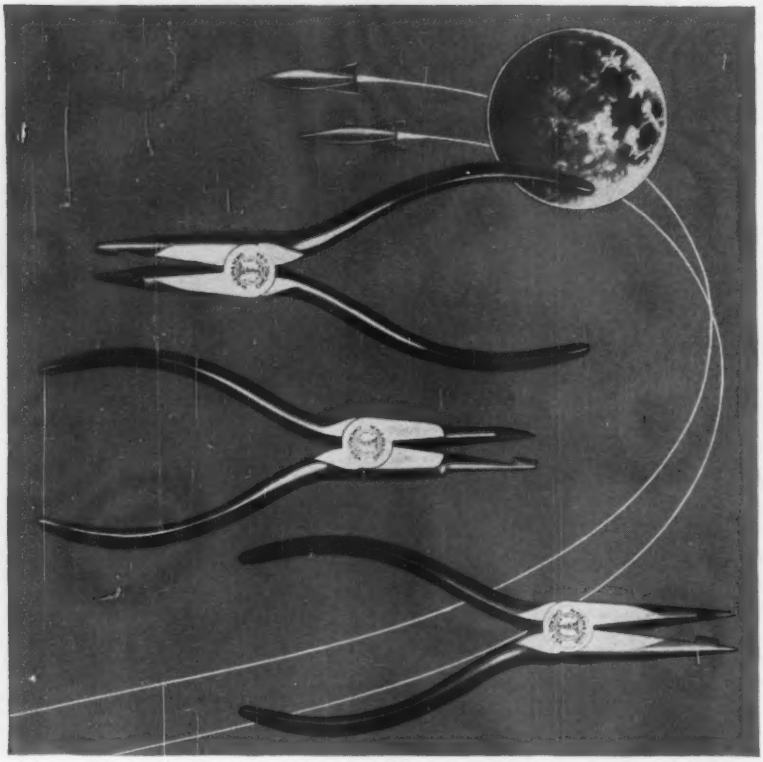
CIRCLE 259 ON READER SERVICE CARD 259

THREE KLEIN PLIERS

to make electrical wiring easier



Here are three newly engineered Klein Pliers which will solve difficult problems in the wiring of electronic assemblies. Catalog 103-A describes these and scores of other pliers in the complete Klein line. If you wire electronic assemblies, write for a copy.

ALL-PURPOSE ELECTRONIC PLIER
Patent pending

Shear blade cuts flush and holds clipped end of wire

Requires no sharpening; will cut hard or soft wire. Smooth, continuous action prevents shock which may damage resistors. For bare wire up to 18 gauge.

No. 260-6—length 6⅜"

No. 260-6C—with coil spring that holds jaws open

NEEDLE-NOSE PLIER Patent pending

Similar to No. 260-6 but nose has been slimmed down to permit use in confined areas.

No. 261-6—length 6⅜"

No. 261-6C—with coil spring to hold jaws open

LONG-NOSE PLIER—KNIFE AT TIP
Pat. No. 2,848,724

Jaws behind blade hold clipped wire end firmly

A shear-cutting plier that will cut hard or soft wire. Blade is at the tip of the plier. Supplied with coil spring to keep jaws apart.

No. 208-6PC—length 6⅜"

Write for Catalog 103-A, which shows the complete line of Klein Pliers, including 20 pliers recently developed.

Mathias KLEIN & Sons
Established 1857
Chicago, Ill., U.S.A.
7200 McCORMICK ROAD • CHICAGO 45, ILLINOIS

band video amplifier performance. Typical neutralized power gain at 30 Mc is 18 db and 2N698 will attain 30 percent oscillator efficiency at 70 Mc. Power rating in TO-5 package is 2 w at 25 C case temperature. Transistor conforms to environmental requirements of MIL-S-19500B.

CIRCLE 445 ON READER SERVICE CARD

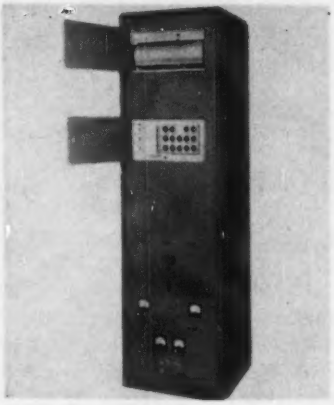


Image Storing System
instant recall

IMAGE INSTRUMENTS, INC., 2300 Washington St., Newton Lower Falls 62, Mass. New system makes it possible to instantly store and immediately recall a tv picture. It records the signal in an electrostatic storage tube; uses no film, tape or other expendable material and does not require developing or other processing. The Electrostore is a means for storing a single frame of television at the touch of a button and then immediately making this stored picture available for prolonged study or examination on a conventional tv monitor. The system has input and output video bandwidths of 8 Mc and an overall resolution which exceeds that of a conventional tv system.

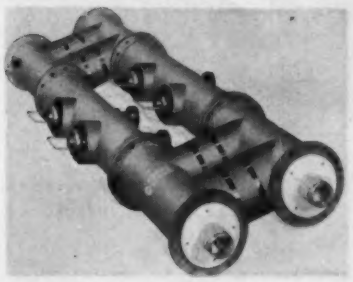
CIRCLE 446 ON READER SERVICE CARD

Test Equipment
large waveguide

DOUGLAS MICROWAVE CO., INC., 252 E. Third St., Mt. Vernon, N. Y., announces a new line of MACRAwave (large waveguide) test equipment

and components. Units include adapters, test horns, attenuators, signal samplers, switches, tuners, wave meters, etc., supplied in the following EIA designated tubing sizes: WR77, WR975, WR1150, WR1500, WR1800, WR2100 and WR2300.

CIRCLE 447 ON READER SERVICE CARD



Duplexer coaxial line

BOMARC LABORATORIES, INC., Salem Road, Beverly, Mass., announces the BL-595 balanced coaxial line duplexer. It consists of two coaxial hybrids and two cavities for plug-in cell-type TR tubes. This unit is in 6⅛ in. line and is rated to handle 10 Kw of average power. Other units of this type are available in 1⅝ in., 3⅛ in. and 6⅛ in. coaxial line.

CIRCLE 448 ON READER SERVICE CARD

Sinusoidal Pots two standard lines

TECHNOLOGY INSTRUMENT CORP., Main St., Acton, Mass., announces two complete standard lines of precision sinusoidal pots: the low torque, ball bearing, servo mount PVR series for servo control applications, and the high torque, sleeve bearing TP series for panel controls. A complete range of diameters from ¾ in. to 3 in. and resistance calues from 1 K to 50 K enables the

THIRTEEN INDISPENSABLE CHARACTERISTICS FOR *Precision* SERVO POTS

PRECISION SERVO POTENTIOMETERS HAVE ALL 13 FEATURES

Your Assurance of Superior System Performance

1 High Reliability
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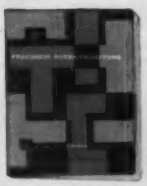
6 Wide Resistance Range
7 Low Phase Shift Over Wide Frequency Range
8 Low Noise Level
9 Highly Precise Non Linear Functions
10 Can Be Ganged
11 Long Life
12 Close Mechanical Tolerances
13 Withstand Extreme Environmental Conditions

A few of the many applications of TIC Precision Servo Potentiometers are as input-output transducers in servo systems for airborne navigation and flight control, fire control, fuel control, shipboard gun directors, missile aiming and flight control, analog computing, air traffic control and telemetering.

TIC Precision Servo Potentiometers are available in 21 types with diameters from ½" to 3", giving design engineers a wide range from which to select. Included are single and multi-turn types with either wirewound or infinite resolution metallic film resistance elements, as well as types designed for ganging without a shaft. And TIC Precision Servo Potentiometers are engineered to withstand the severe environmental conditions imposed by military equipment operation.

Write or call for this new catalog on the TIC line of Precision Potentiometers - the most complete line on the market.



Type MFR — encapsulated contact patented Metifilm, ultra-reliable, long life potentiometers.

PVR05

PVR09 (ganged)

PVR15
Type PVR — new, complete line of low torque high accuracy, performance proved, servo type precision potentiometers.

M10T09
Type M10T09 — multi-turn (3, 5, 10-turn) highly accurate precision potentiometers.

C10-09 (ganged)
Type C10-09 — 10 turn may be ganged

RVBC2
Type RVBC2 — unitized construction for development work.

PT¼
Type P 1¼ — low cost commercial grade, precision potentiometers

TECHNOLOGY INSTRUMENT CORP.
569 MAIN STREET, ACTON, MASS.

SUBSIDIARIES: ACTON LABORATORIES, INC., ACTON, MASS. • ALTOMAC CORP., CANTON, MASS.
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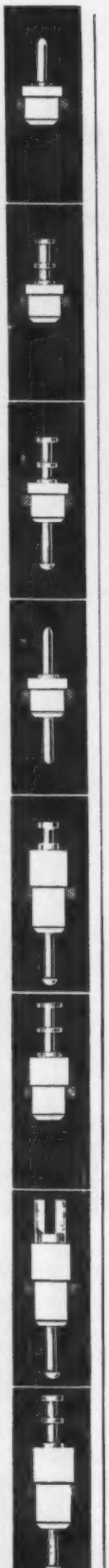
Visit us at Booth 2317-19 at the IRE Show.

TAURUS TERMINALS OF TEFLON*



We are specialists in manufacturing STANDOFF & FEEDTHRU TERMINALS insulated with Teflon*. Simplest terminal to install by forcing into undersize chassis hole.

Taurus Terminals are accepted and approved by major users. Taurus is a completely integrated, experienced and quality minded manufacturer of terminals.

*REG. T.M. OF E. I. DUPONT

TAURUS PUNCHED CARD SENSORS

Read Entire Punched Card Statically

FOR SIMPLE SWITCHING USING STANDARD PUNCHED CARDS

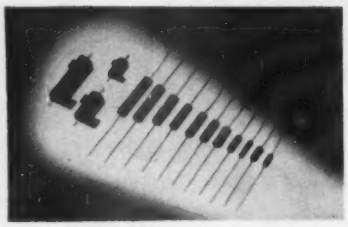
The Sensor statically reads entire standard I.B.M. or Remington Rand punched cards. Each hole position has a corresponding closed switch, and each unpunched hole position has a corresponding open switch when the Sensor is actuated.

Used for automatic test equipment and other automatic devices.

TAURUS CORPORATION
8 Coryell Street
Lambertville, New Jersey

systems designer to select the smallest size consistent with his other requirements. Dual wipers phased 90 deg apart and separate slip rings are provided in all standard units to produce both sine and cosine simultaneously from a single pot. Many sections of adjustable phasing can be ganged together on a common shaft permitting a wide variety of sinusoidal outputs.

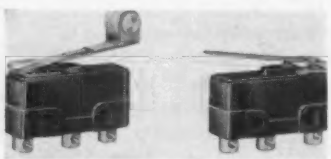
CIRCLE 449 ON READER SERVICE CARD



Power Resistors wirewound

SAGE ELECTRONICS CORP., East Rochester, N. Y. New miniature precision wirewound power resistors (types NS and NM) incorporate two major improvements: they are noninductively wound, and are coated with Impervohm silicone coating. Among the advantages of the new coating are: improved moisture and heat resistance; improved resistance to cleaning fluids such as trichlorethylene and other flux removers; also improved insulation and electrical properties. Type NS are available in 2, 3, 5, 7 and 10 w ratings; type NM (metalclad), in 10, 25 and 50 w ratings. Both provide tolerances to 0.1 percent.

CIRCLE 450 ON READER SERVICE CARD

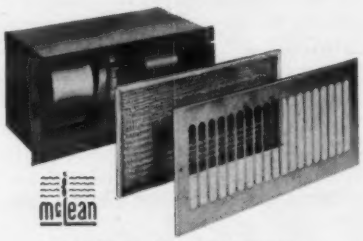


Subminiature Switches integrally actuated

HAYDON SWITCH, INC., Waterbury, Conn. Type 5300 subminiature switches with integral leaf and roller leaf actuators. Switch assembly saves space and is suited for

"There's a guy here from McLean, says he can cool anything!"

. . . anything electronic that is, but we're glad to see that our reps get around. McLean specializes in packaged cooling systems. They're rack mounted for easy installation and service.



McLEAN MODEL 2E408

The industry's standard . . . over 15,000 in use all over the world. High velocity, fast cooling. (7" x 19", 300 cfm).

Extend the life of sensitive tubes, transistors and other components with McLean packaged cooling units. Prevent system failure . . . maintain calibration and accuracy.

Over 100 models in various panel heights and CFM's. Mil. Spec. equipment for packaged cooling also available.

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44 Page Packaged Cooling Catalog

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TWX Princeton, New Jersey 636
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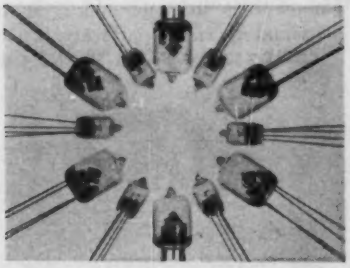
CIRCLE 349 ON READER SERVICE CARD

ganging in cam-actuated and limit-switch applications when multiple pole switching is required. Assembly time is shortened since adjustment of a separate auxiliary actuator to a basic switch is eliminated. Operating force of the switches is 6 oz max, overtravel ¾ min. Temperature ratings are −65 F to +250 F.

CIRCLE 451 ON READER SERVICE CARD



Trigger Tubes
cold-cathode

CBS ELECTRONICS, Danvers, Mass., anounces an expanded line of six miniature and six subminiature Krytrons, cold-cathode devices for triggers, timers, regulators, and pulsers. The devices match the most stable circuit elements in reliability and ruggedness and provide conservative safety margins for extreme conditions of heat (+85 C), cold (−55C), shock (2,000-2,800 g), and vibration (10 g at 0-5,000 cycles). The Krytrons feature very high hold-off voltages, low grid driving current, high instantaneous plate current, short anode delay time, and negligible jitter. They are compact and light-weight to fit neatly into potted and printed circuits.

CIRCLE 452 ON READER SERVICE CARD

Precision Resistors
encapsulated

JULIE RESEARCH LABORATORIES, INC., 556 W. 168th St., New York 32, N. Y. Group-encapsulated form of JRL L-type premium-grade precision wire-wound resistors. Con-

CIRCLE 30 ON READER SERVICE CARD

CIRCLE 263 ON READER SERVICE CARD

'DIAMOND H' RELAYS

NEW . . . High Speed Polarized Relays

Fast action with freedom from bounce, plus high sensitivity and consistent operation with low distortion, are provided by small, rugged Series P Polarized Relays. SPDT, with two independent coils, they will handle over 1,000 pulses per second. Various coil resistances up to 5,000 ohms each coil. Contact ratings vary with switching speed but range from 60 MA to 2A with voltages to 120 AC or DC, dependent upon amperages employed.

Aircraft-Missile Series R & S Relays

Miniature, hermetically sealed 4PDT, Series R & S relays provide excellent reliability over their long service life. Electrically and physically interchangeable, the two series differ only in that Series S coils are separately sealed within the sealed cases, with organic matter eliminated from the switch mechanism for greatest reliability in dry circuits. Contacts MA to 10 A.

Special Mountings

Series R/S Relays are available with 10 standard mounting arrangements, plus a ceramic plug-in socket. MS-AN type connector mounting, illustrated at right, makes assembly, installation and field service extremely simple, while the connector provides a seal against moisture.

"Diamond H" engineers are prepared to work with you to develop variations on these relays to meet your specific requirements. Tell us your needs . . . by phone or letter.

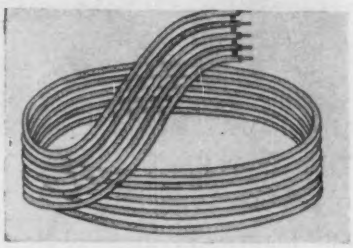
'THE HART MANUFACTURING COMPANY

202 Bartholomew Ave., Hartford 1, Conn.

Phone JAckson 5-3491

struction provides tolerance of ±0.01 percent standard to ±0.003 percent if required, also long-term stability of ±0.003 percent per year standard, ±0.001 percent per year if required. Up to 12 sections can be encapsulated in one compact assembly. Resistance range per section is from one ohm to two megohms and maximum voltage per section is 125 v for ½-w units or 250 v for 1-w units. Maximum diameter is ⅝ in., and length is approximately 1¼ in. per watt.

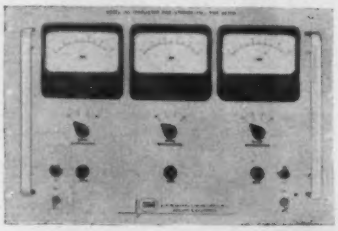
CIRCLE 453 ON READER SERVICE CARD



Flat Bonded Cable low capacitance

SPECTRA-STRIP WIRE & CABLE CORP., Box 415, Garden Grove, Calif., has extended its flat bonding technique into the field of low capacitance cables and harnesses. The conductors in this Verilocap cable are spaced apart by means of high quality vinyl tubing, and the result is an attractive looking cable with extremely low inter-conductor capacitance.

CIRCLE 454 ON READER SERVICE CARD

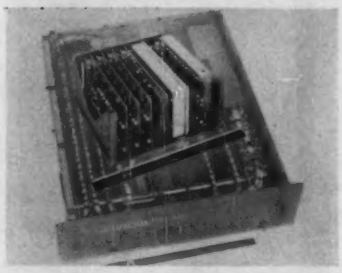


Transistor Meter direct read-out

E-H RESEARCH LABORATORIES, 1922 Park Blvd., Oakland 6, Calif., has available a device for measuring the switching characteristics of transistors. Model 140 rise, storage and fall time meter provides a di-

rect read-out allowing very fast measurements to milliμsec accuracies. Time is displayed directly on panel meters or presented as voltages in full scale ranges from 10 milliμsec to 10 μsec, for each of three independently adjustable time difference channels. The instrument is particularly suitable to production line or routine inspection testing methods, as well as laboratory usage.

CIRCLE 455 ON READER SERVICE CARD



Airborne Converter
analog-to-digital

PACKARD BELL COMPUTER CORP., 1905 Armacost Ave., Los Angeles 25, Calif. Completely transistorized for minimum size and maximum reliability, the model M4 performs a 12-bit conversion to an accuracy of ±1 mv in 65 μsec. over the temperature range of −55 C to +70 C. Available for 3-decimal digit as well as 12-bit binary conversion, the M4 is designed to meet the conditions required of MIL-E-5400B and MIL-E-005272. Packaging conforms to MIL-T-19600 (AER).

CIRCLE 456 ON READER SERVICE CARD

Silicon Resistors
wider ohmic range

TEXAS INSTRUMENTS INC., Semiconductor-Components Division, P. O. Box 312, Dallas, Texas, has available Sensistor silicon resistors with values extending from 68 ohms to 1.8 K ± 10 percent tolerance. Special values from 62 ohms to 2 K with tolerances of ± 5 percent and ± 10 percent are also available. By extending ohmic range TI has increased the capability of this low cost, lightweight device to meet the urgent need for temperature-stable circuitry. Units are available in three types: TM ¼ and TM ½ axial

NEW!... CONVERTS AC to DC LINEARLY

from 1 mv to 1000 v

Accuracy of conversion is BETTER THAN 0.25% for frequencies 50 cps to 10 KC

Price $450

BALLANTINE'S LINEAR AC to DC CONVERTER
Model 710

The Model 710 Linear AC to DC Converter converts an AC voltage to a DC voltage which can be measured with an accurate DC device such as Type K Potentiometer, Digital DC Voltmeter, Recorder, etc. With such a combination, a wide range of voltages can be measured with up to 0.25% accuracy, which is considerably better than accuracies of present-day vacuum tube voltmeters. Such a system is more sensitive, covers a wider frequency and voltage range, and is much more rugged and foolproof than a laboratory standard instrument of comparable accuracy. It is also adaptable for use by untrained personnel and on production lines.

The instrument covers an input voltage range of 1 mv to 1000 volts which is divided into six decade ranges. For every decade range the DC output varies from 0.1 volt to 1 volt. The input impedance of the converter has a resistive component of 2 megohms shunted by 15 pf to 25 pf, depending on the range.

The output of the Model 710 Converter is a linear function of the input voltage within each decade. A small error may exist in the decading of the input attenuator or in the frequency response of the amplifier. This error does not exceed ±0.25% over a frequency range of 50 cps to 10 KC and ±0.5% over a range of 30 cps to 50 KC. The upper frequency limit of the instrument is 250 KC, at which point the accuracy is ±1%.

The DC output of the converter is single ended and has a maximum output emf of 1 volt with a source impedance of approximately 10,000 ohms. The instrument is the average responding type for distortions as much as 30%, but is calibrated in RMS of a sinewave.

Also available in 19 inch relay rack as Model 710 S/2 Price $455

Write for brochure giving many more details

— Since 1932 —

BALLANTINE LABORATORIES INC.

Boonton, New Jersey

CHECK WITH BALLANTINE FIRST FOR LABORATORY AC VACUUM TUBE VOLTMETERS, REGARDLESS OF YOUR REQUIREMENTS FOR AMPLITUDE, FREQUENCY, OR WAVEFORM. WE HAVE A LARGE LINE, WITH ADDITIONS EACH YEAR. ALSO AC/DC AND DC/AC INVERTERS, CALIBRATORS, CALIBRATED WIDE BAND AF AMPLIFIER, DIRECT-READING CAPACITANCE METER, OTHER ACCESSORIES.

FOUND: a way to reduce transistor inspection costs 50% or more

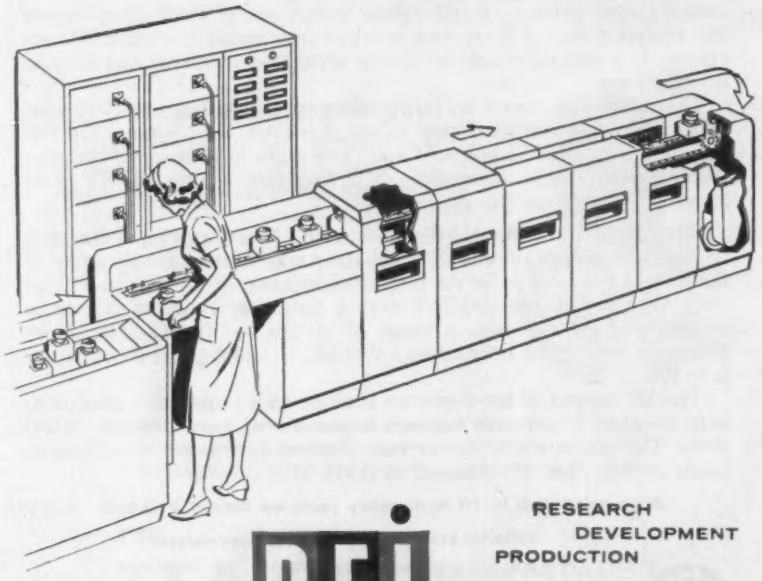
Dfi — Cleveland's Automatic Transistor Test Set eliminates manual inspection. Promised: a major reduction in manufacturing cost.

- Automatically tests, rejects and classifies at 2400 units/hr. maximum rate.
- Performs as many as 38 tests—all required parameters.
- Master card programming permits instant set-up for every transistor type.
- Unitized design provides optimum flexibility to meet present and future requirements.
- Design concept is applicable to diodes, capacitors, resistors.

Name your parameters, and the unit performs all tests automatically—orientation, short circuits, 15 d-c tests, 21 a-c tests and 4 optional environmental tests.

Tests at each of 14 stations can be programmed separately, and in correct relation to each other. Then, master cards can be used to program complete inspection and sorting of every transistor type you make. All tests are self-checking. Stations are unitized, permitting easy modifications, additions or deletions. The entire unit should amortize within six months.

Write for product bulletin. Firm prices and delivery will be quoted on request. (The Transistor Test Set is an example of Dfi's ability to solve a complicated automation problem. Tell us about *your* problem.)



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DEVELOPMENT
PRODUCTION

DFi CLEVELAND
Designers for Industry, Inc.
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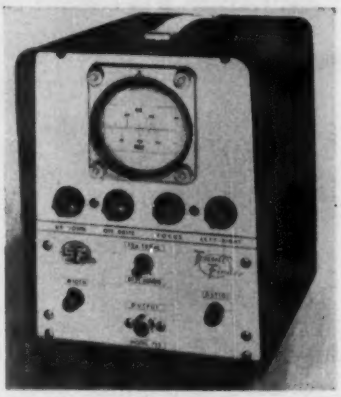
lead molded units, and the TC ⅛ in the standard JEDEC TO-5 round welded case. The devices now have wider application in amplifiers, power supplies, servos, telemetering, magnetic amplifiers, computer switching, thermometry—and also for bias stabilization in a-c coupled stages and first stage of d-c amplifiers.

CIRCLE 457 ON READER SERVICE CARD



Cable Fault Finder
3-percent accuracy

SMITH-FLORENCE, INC., 4228-23rd Ave. West, Seattle 99, Wash. Model 722 presents a new approach to the solving of cable fault-problems. Using the radar principle obsoletes the use of resistance and capacitance computation to locate faults. By measuring elapsed time between a transmitted pulse and any resulting reflections, it quickly and accurately locates shorts, opens, mismatches or intermittents in coaxial or multiple conductor cables from 10 to 200 ft long. A crt is utilized to display a convenient picture of the cable being tested. Faults appear as deflections along the horizontal trace across the screen.

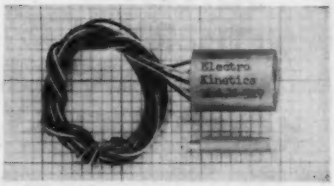
CIRCLE 458 ON READER SERVICE CARD

Power Transistor
military-type

BENDIX AVIATION CORP., 201 Westwood Ave., Long Branch, N. J. The 2N1011 germanium *pnp* power transistor is designed to meet specification MIL-T-19500/67 (Sig. C). Maximum collector-emitter voltage rating is 70 v and collector current rating is 5 amperes. Unit will readily dissipate 35 w at 25 C and 10 w

at 75 C. High current switching, audio amplification, small motor and servo drivers are typical applications to regulators, power supply and oscillator circuits. These transistors feature welded construction with a vacuum-tight seal to assure long life and stable operation.

CIRCLE 459 ON READER SERVICE CARD



LVDT Transducer
miniature device

PACIFIC ELECTROKINETICS, 329 S. Vermont Ave., Glendora, Calif. New LVDT transducer with extreme sensitivity and large output for small linear movement has been developed for computers, pressure sensing devices, laboratory and atomic-nuclear instruments, also missile, aircraft, ground support and industrial applications. Model N-329 has an input voltage of 26 v a-c at 400 cps with a sensitivity of 60/mv/0.001 in. with a nonlinearity of 0.1 percent over a range of ±0.010 in. Length of the housing is 1 in. with a diameter of ¾ in. Probe is provided with extensions for linkage at both ends. Operating range is −65F to +220 F.

CIRCLE 460 ON READER SERVICE CARD

Delay Lines
lumped constant

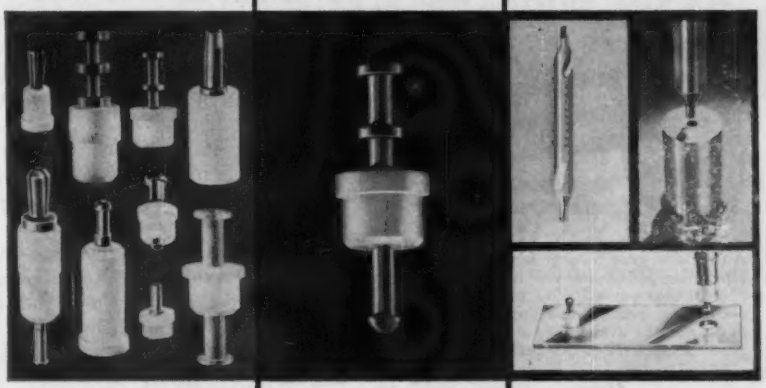
VALOR INSTRUMENTS, INC., 13214 Crenshaw, Gardena, Calif. Five lumped constant delay lines with delays of 0.1, 0.25, 0.5, 1.0 and 1.1 μsec are available in kit 123. Each has a 4 to 1 delay to rise time ratio and is molded in a 0.4 in. by 1.5 in. hermetically sealed brass tube with

Sealectro PRESS-FIT®
GOES THE LIMIT
TO GUARANTEE
THE BEST TERMINAL

1
Over 1000 types of Teflon terminals
The widest choice in the industry—one for every known application. **Plus,** an outstanding, fast design and sampling service for every new application.

2
Made to the most rigid tolerance
Every "Press-Fit" terminal is made to pre-determined tolerances engineered to do the job right, every time. Saves time, trouble and rejects in assembly operation.

3
With proper, available assembly tools
Punch and dies for large runs, special 2-step drills for small-run chassis preparation, and insertion tools for fast, accurate terminal installation.



PRESS-FIT TEFLON TERMINALS
The Complete Terminal System Concept

You buy more than a piece of hardware when you specify "Press-Fit" terminals—you buy a complete service that assures you the **best terminal installed.** Sealectro customer service in engineering, and delivery is the best in the industry.

Visit Sealectro Booth 2922 at IRE Show

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PRESS-FIT TEFLON TERMINALS
CON-HEX RF CONNECTORS
British Branch: Sealectro Corporation, Hersham Factory Estate, Lyon Road, Walton-on-Thames, Surrey, England.

Another FIRST from ALI

NEW PACKAGED PRECISION DRIVE UNITS

Now, for the first time you can obtain precision drive units complete in one package. ALI Drives save time, trouble and money — eliminate the need of procuring and assembling separate indicators, dials, knobs, gears, etc. And, with ALI Precision Drive Units you know you have a unit that will do the required job without a possibility of error. Use them with rotary components such as resolvers, syncros, potentiometers, inductors, capacitors, tuning coils, etc.

REQUIRE NO ADDITIONAL PARTS

TYPE PDW-1 PRECISION DRIVE, WORM . . .
Accuracy 1 min. of arc

A worm gear, shaft positioner for accurate repeatable positioning and indicating. Features: no backlash, compact design, long life, rugged construction. Mechanism utilizes a 180-1 ratio allowing direct dial readings of 1 minute of arc. Has hairline indicator, large engraved dials.

ARE COMPLETE UNITS IN THEMSELVES

TYPE DSD-2 DUAL SPEED DRIVE . . .
Accuracy 6 mins. of arc

A precision gear reducer for highly-accurate repeatable positioning and indicating. Inner dial for coarse positioning, outer dial for fine positioning plus in-line input and output shafts and the availability of a wide range of ratios through 72-1. No backlash.

3 TYPES AVAILABLE
all meet Mil-E-4970 (USAF)

TYPE DSD-3 DUAL SPEED DRIVE . . .
Accuracy 12 mins. of arc

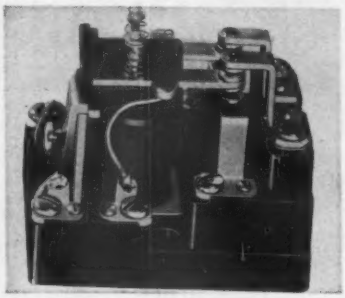
An economical precision gear reducer for positioning and indicating. Features: no backlash, in-line input and output shafts, compact design. Like Type DSD-2, it has inner dial for coarse positioning, outer dial for fine positioning.

Write for full details

ACTON LABORATORIES INC.
Subsidiary of Technology Instrument Corp.
517 MAIN STREET, ACTON, MASS.
COLONIAL 3-7756
Visit us at Booth 3840-42 I.R.E. Show

a fused tin plate finish. Designed for transistor and p-c applications, they have attenuations ranging from 1 percent to 3 percent. The low insertion loss is obtained by using miniature toroidal inductors, which enable relatively large values of inductance to be achieved with an extremely low d-c resistance and high Q. Price is $97.50.

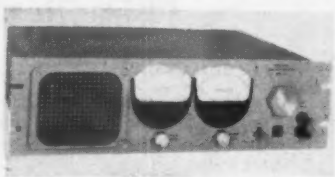
CIRCLE 461 ON READER SERVICE CARD



Power Relay for h-v switching

LINE ELECTRIC CO., 271 South Sixth St., Newark 3, N. J. Series ST power relay is ideally suited for starting motors up to 1 h-p, elevator controls, and many other applications requiring high current or high voltage switching with a maximum in dependability. It is presently available in dpdt models only, and features one piece molded base construction coupled with shielded screw type electrical connections. Contact rating is 15 amperes rated at 115/60. Available voltages range from 6 v d-c to 110 v d-c and all standard a-c voltages up to 440 v a-c. Contact material is gold flashed fine silver, $\frac{1}{16}$ in. in diameter.

CIRCLE 462 ON READER SERVICE CARD



Power Supplies transistorized

QUAN-TECH LABORATORIES, 60 Parsippany Blvd., Boonton, N. J., announces the 120 series power supplies. Regulation is ±0.01 percent or ± 3 mv from no load to full load or from 105 v to 125 v line. Ripple

CAN YOU

MEASURE JUNCTION THERMAL IMPEDANCE REPRODUCIBLY

TEST CONTROLLED RECTIFIERS DYNAMICALLY

GENERATE ONE 5000 AMP. SINUSOIDAL PULSE

EVALUATE A 500 AMP. RECTIFIER AT 1500 VOLTS

...We Can!

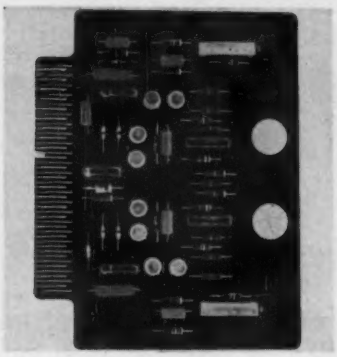
BRING YOUR DIODES AND HEAT SINKS TO BOOTH #3006

WALLSON ASSOCIATES, INC.
912-914 Westfield Ave., Elizabeth, N. J.

CIRCLE 350 ON READER SERVICE CARD

is less than 500 μv. rms. All-electronic circuitry protects each of the four presently available units from overload or short circuit, and recovery is immediate when the fault is removed. The same circuitry automatically limits the dissipation in the transistors to a safe value. The four units have distinct but overlapping output voltage and current ranges—from 0.1 to 50v d-c, and 0 to 5 amperes. Prices range from $475 to $645.

CIRCLE 463 ON READER SERVICE CARD



Pulse Generator
variable frequency

ABACUS, INC., 3040 Overland Ave., Los Angeles 34, Calif. These plug-in modules operate either as free-running or one-shot multivibrators. Combinations of generators can be formed to produce arbitrary pulse trains with variable pulse widths and variable frequencies. They provide the two-phase clocks for Abacus Sheffer stroke digital modules and can be used in a variety of other applications. Frequency is adjustable from 1 Kc to 100 Kc. Pulse widths are independently variable from 4 μsec to 100 μsec. Rise time is 0.5 μsec or less. Output current is 75 ma for 7 v output-pulse amplitude. Each output drives over 100 Abacus stroke gates.

CIRCLE 464 ON READER SERVICE CARD

Power Supplies
low voltage line

POWER SOURCES, INC., Burlington, Mass. A low voltage line of transistor-regulated power supplies consists of three models (PS4305, PS4315 and PS4330) with current ranges of 0-5, 0-15 and 0-30 amperes respectively. Voltage range

Simplified A. C. Transfer Standard

Coaxial Design for Broad Frequency Response and Ease of Operation

Model TV 1

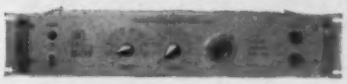
THERMAL TRANSFER VOLTMETER

RANGE .5 volts to 1200 volts three decade range multiplier.

NULL SENSITIVITY .04%/C.M. L & N Type 2430A Galvo Provided

THERMO-COUPLE TEMPERATURE MEASUREMENT

The Thermo Couple Potentiometer is calibrated in percent of A.C. Input voltage. Calibration on 2 decades switches and 10 turn pot. This allows operator to read frequency response in percent without D.C. transfer. Zener regulated supplies eliminate battery drift.



THERMO-COUPLE

D. C. Reversal Error less than .02%. Couples plug in replacable $40.00. Couple operated in thermally balanced bridge to eliminate temperature drift.

FREQUENCY RESPONSE

.5 to 290 volts .02% to 50 KC 300 to 1200 volts .02% to 10 KC Calibration curves provided to 5 megacycles with accuracy of 0.1%.

D. C. TRANSFER

Transfer measurement is made to a calibrated D. C. supply of the same voltage as the unknown A. C. being measured. This eliminates ratio errors in the high frequency multiplier resistors.

Write **for complete information.**

See **us in Booth No. 3814 at the IRE SHOW, or at main exhibit in St. Moritz Hotel.**

Holt INSTRUMENT LABORATORIES
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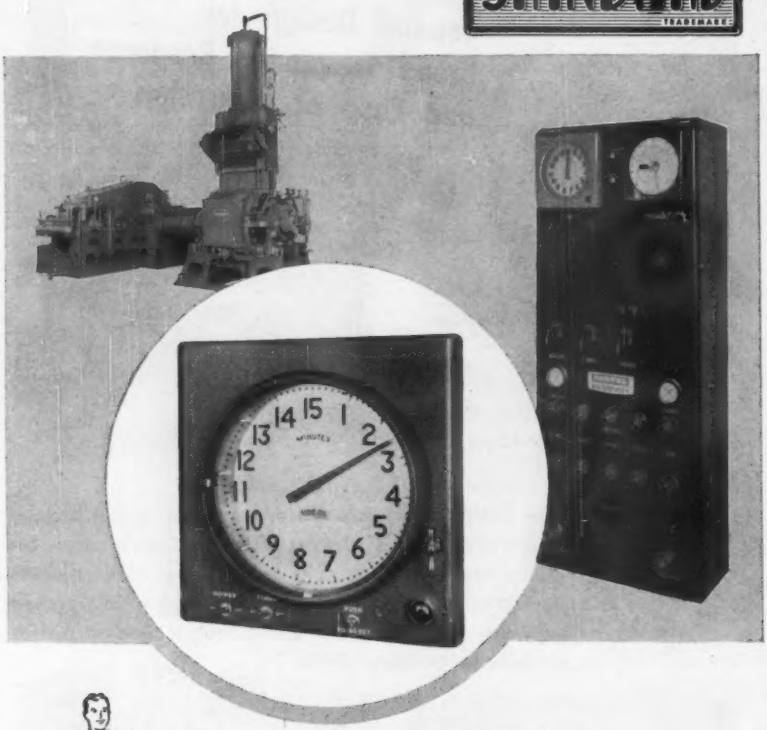
Actuating Audible Signals . . .

Another of Countless Applications of

SPECIAL TIMERS by STANDARD



A specially developed Standard batch timer, with pins which can be positioned as desired, actuates audible signals to assure proper manual operation of critical equipment.

What's *your* need in special timers? Precise process timing—as on this Farrel-Birmingham Banbury® mixer? Or accurate test timing (to tolerances of ± .001 second)—as with numerous electronics and missile manufacturers?

Whatever the application, STANDARD stands ready to develop the exact elapsed time indicator to meet the most stringent requirements.

Inquire today.

Request Catalog No. 198A covering the full line of STANDARD Precision Timers . . . portable or panel mounted.

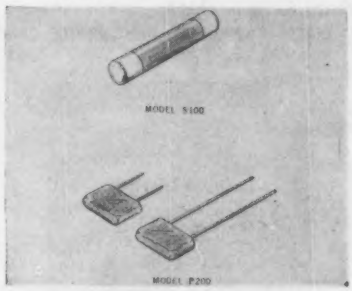
"Splitting the Split Second . . . Precisely"

THE STANDARD ELECTRIC TIME COMPANY

89 LOGAN STREET, SPRINGFIELD, MASSACHUSETTS

of all three is 6-36 v d-c. Output voltage is selectable by a control on the front panel. Ripple and noise level at the output is less than 1 mv. Regulation is provided to maintain output voltage within 0.025 percent for 10 percent line changes and load changes of from zero to full load. All models are fully short-circuit protected.

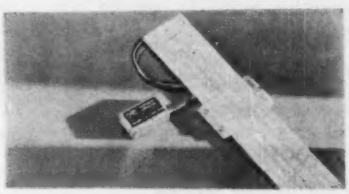
CIRCLE 465 ON READER SERVICE CARD



Current Limiter solid state

MICROLECTRON, INC., P. O. Box 24174, Los Angeles 24, Calif. Solid state current limiter was designed for use in all types of electronic circuits, especially where the ultimate in protection is required. It is said to act 300 to 400 percent faster than does any related device. It is a one-shot device which will fire in less than 1 msec at 316 percent rated value or $\frac{1}{10}$ sec at 150 percent rated value. The current limiter is available in ratings from $\frac{1}{32}$ ampere to 5 amperes in 2 configurations: Model 100—$\frac{1}{4}$ in. by 1 in., to fit a standard fuse holder; model 200—$\frac{1}{4}$ in. by $\frac{1}{2}$ in. by $\frac{1}{16}$ in., pigtail type for printed circuits.

CIRCLE 466 ON READER SERVICE CARD

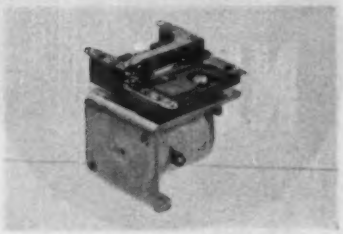


Transistor Amplifier subminiature

TABER INSTRUMENT CORP., 107 Goundry St., North Tonawanda, N. Y. Subminiature transistor amplifier for servo, audio and pulse applications is a moderate temperature, medium gain voltage amplifier

for severe vibration conditions. Features are small size and gain stability over a range of operating temperatures from − 50 C to + 50 C. Built-in current limiting devices make "runaway" impossible and the unit cannot be damaged by short circuited output or by reversing the power supply. Open loop gain is over 40 db and closed loop gain is 10 db to 26 db. Amplifier is enclosed in a stainless steel case and has a vibration specification of 400 g's at 2 Kc without microphonic noise.

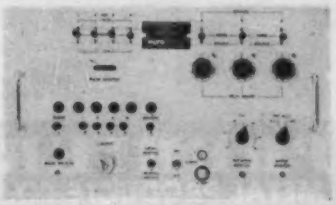
CIRCLE 467 ON READER SERVICE CARD



Compact Relay
general purpose

F. A. SCHERMA MFG. CO., INC., 424 Broome St., New York 13, N. Y. This unit originally designed for antenna switching in the 200 Mc range, can be used very efficiently as a general purpose relay. It uses a one piece molded block for contact mounting. It is available with silver contacts (rated at 5 amperes) or palladium contacts (rated at 3 amperes). Other contact materials for special applications are available on special order. Contacts are so spaced as to achieve low crosstalk. The relays are designed to operate continuously at any ambient temperature from −30 C to +100 C.

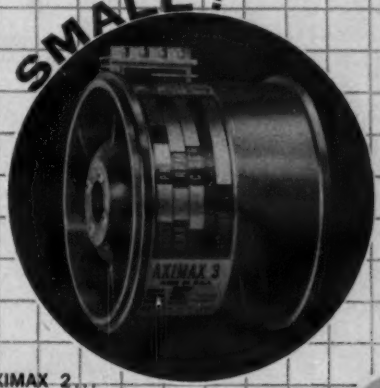
CIRCLE 468 ON READER SERVICE CARD



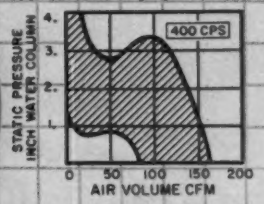
Modulator Pulser
command type

ALTO SCIENTIFIC CO., INC., 855 Commercial St., Palo Alto, Calif. Model P-31 command modulator pulser contains four separate phas-

SMALL!

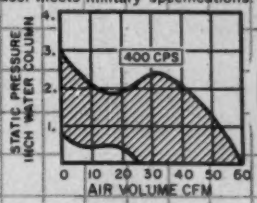


AXIMAX 3... Fan measures 3¼" dia. X 2⅜" and weighs 14 ounces. Available in 115 or 200 VAC, 400 CPS, 1 Phase or 3 Phase. Meets applicable military specs.

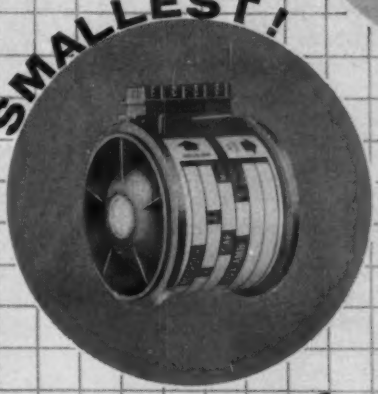


SMALLER!

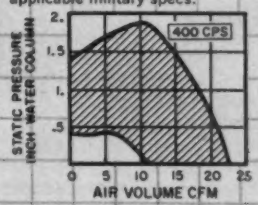
AXIMAX 2... Fan size only 2" dia. X 1½" and weighs 4½ ounces. 115 or 200 VAC, 400 CPS, 1 Phase or 3 Phase. Meets military specifications.



SMALLEST!



AXIMAX 1... Dimensions 1½" X 1½", weight only 4 ounces. Choice of motors from 115 or 200 VAC, 400 CPS, 1 Phase or 3 Phase. Meets applicable military specs.



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400 CPS FANS

for maximum cooling in minimum space

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CIRCLE 271 ON READER SERVICE CARD

North Atlantic Series RB500 Ratio Boxes

Model RB-501
Rack mount

Measure A.C. Ratios From −0.011111 To +1.11111...with accuracy to 1 ppm

With any of North Atlantic's RB500 Ratio Boxes you can now measure voltage ratios about zero and unity—without disrupting test set-ups.

And—a complete range of models from low cost high-precision types to ultra-accurate ratio standards—in portable, bench, rack mount, binary and automatic stepping designs—lets you match the model to the job.

For example, characteristics covered by the RB500 Series include:

Frequency: 25 cps to 10 kc.
Accuracy: 10 ppm to 1.0 ppm
Input voltage: 0.35f to 1.0f
Input impedance: 60 k to 1 megohm
Effective series impedance: 9 ohms to 0.5 ohms
Long life, heavy duty switches

Name your ratio measurement and its probable there's a North Atlantic Ratio Box to meet them—precisely. Write for complete data in Bulletin 11G

Also from North Atlantic
...a complete line of complex voltage ratiometers...ratio test sets... phase angle voltmeters

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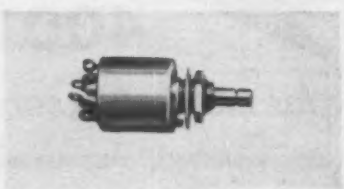
shift oscillators (with plug-in frequency control networks) covering the approximate frequency range of 50 to 1,000 cps. A set of front panel push buttons simultaneously selects any two oscillators. The two selected channels are fed to a passive adder circuit and thence to a cathode follower stage. Unit also contains a prf generator in the range of 200-2000 groups/sec and delivers a complex three pulse output train, in which each pulse can be varied in time from 10 μsec to 100 μsec. One of the three pulses is delay modulated between 0 and ± 10 μsec from the nominal value by the added frequency output of two selected phase shift oscillators.

CIRCLE 469 ON READER SERVICE CARD

Delay Lines
distributed constant

GRAY & KUHN, a division of IMC Magnetics Corp., Westbury, N. Y., announces distributed constant delay lines designed for maximum delay/rise time ratio. They operate over a temperature range of −55 C to +105 C; temperature stability is 0.015 percent per deg C delay; 1,000 ohms impedance ± 10 percent; attenuation 20 percent maximum; distortion within ± 10 percent. Hermetically sealed in a drawn steel casing, each unit consists of six ceramic rods, coated with a silver capacitive element.

CIRCLE 470 ON READER SERVICE CARD



Precision Switch
up to 5 poles

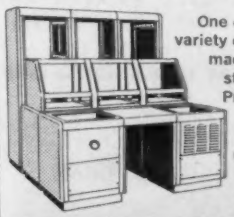
CLAROSTAT MFG. CO., INC., Dover, N. H. Series Bj offers any switching mode from one pole/10 posi-

PREM-O-RAK
BALL-CORNERED MODULAR TRANSMITTER RACKS

22" and 25½" DEEP FOR STANDARD 19" RACK PANELS

Designed for MULTIPLE INSTALLATIONS and for use with PREM-O-RAK CONSOLE SYSTEMS.

RIGIDLY CONSTRUCTED • Frame made of 14 gauge steel • Panel Mounting Angles 3/16" thick • End Panels and Doors made of 16 gauge steel.



One of the unlimited variety of arrangements made possible with standard, flexible Prem-O-Rak units

CONTACT YOUR DISTRIBUTOR or SEND FOR FOLDER S-160A

PREMIER METAL PRODUCTS CO.
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EXPORT DEPARTMENT: EMEC
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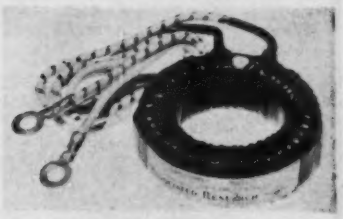
IN CANADA: PREMIER METAL HOUSINGS, Ltd.,
5810 Smart Avenue, Montreal

CIRCLE 177 ON READER SERVICE CARD

tions to five pole/2 positions. Switch is ½ in. in diameter, with a body ½ in. deep. Terminals are of the solder lug type, finished to facilitate soldering and molded in position. The Bj is suitable for applications requiring precision and miniaturization such as portable instrumentation geophysical field equipment, aircraft equipment, computers, and mobile communications equipment. Current carrying capacity is 4 amperes, with a 30 C temperature rise. Contact resistance is 0.005 ohm maximum between any pair of contacts. Current switching capacity is 350 ma, 100 v d-c, with an inductive load of 2.8 henrys. Dielectric strength is 1,000 v rms for 1 minute at sea level; insulation resistance, 10,000 megohms, minimum.

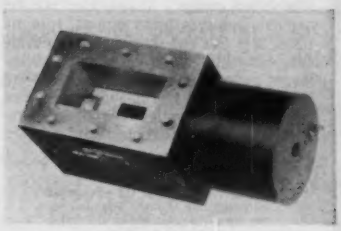
CIRCLE 471 ON READER SERVICE CARD



Current Transformer for metering

ASSOCIATED RESEARCH, INC., 3777 W. Belmont Ave., Chicago 18, Ill. Series 700 line of Donut current transformers are used for extending the range of ammeters, as well as to provide operating current for relays. They are available in ratios from 10/5 to 5,000/5, with burden ratings of 2.5 to 12.5 Kv.

CIRCLE 472 ON READER SERVICE CARD



Rotary Shutter for S-band use

MICROWAVE ASSOCIATES, INC., Burlington, Mass. The MA-788 rotary shutter is a compact, magnetically operated waveguide switch for use in RG-48/U S-band applications

FOR DEPENDABLE HIGH-INTENSITY ILLUMINATION

KEMLITE LABORATORIES USES "LINDE"

XENON

Lighting the way to safer aircraft landings is only one of many important uses for Kemlite Laboratories' new xenon-filled lamps. They are also used in missile-tracking, stroboscopic equipment, and the graphic arts, producing light intensities approximating zenith-position sunlight!

LINDE is a leading producer of rare gases which include xenon, krypton, argon, and neon. These are extracted through a unique liquefaction process pioneered by LINDE to meet the most rigid standards of purity for highly critical applications. For example, LINDE produces xenon of highest purity available, yet this gas exists as only one part in 12 million in atmosphere!

LINDE was first to produce many of the rare gases in wide use today. These are available in pure or mixed form. Mixtures can also be supplied with the radio-active isotope Krypton-85 as an additive.

For information, write Linde Company, Division of Union Carbide Corporation, Rare Gases Dept. E-03, 30 East 42nd Street, New York 17, N.Y. In Canada, Linde Company, Division of Union Carbide Canada Limited, Toronto 7.

"Kemlite" Flash Lamp Type S-471

Linde TRADE MARK

UNION CARBIDE

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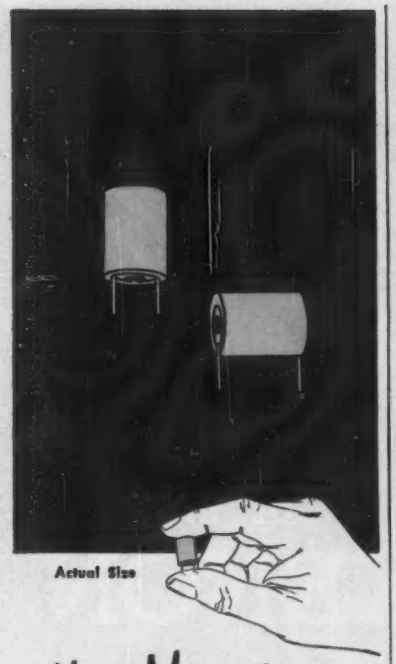

New Miniature

VARIABLE INDUCTOR

FOR VERTICAL OR HORIZONTAL MOUNTING IN PRINTED CIRCUIT BOARDS

This new, ultra tiny Variable Inductor, with amazing subminiature characteristics, has stable inductance at extreme temperature variations and high reliability, along with light-weight and miniature size features.

- **INDUCTANCE RANGE:** 0.10 to 4700 μH
- **INDUCTANCE ADJUSTABLE:** ±20%
- **ENVIRONMENTAL:** Encapsulated in epoxy resin for protection against climatic and mechanical conditions.

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(2,700-3,100 Mc). Operating voltage is 20-29 v d-c. Current at 28 v is 560 ma and coil resistance at 25 C is 50 ohms. In the normally closed position the shutter provides 25 db attenuation for reliable standby protection of receiver elements. In the open position insertion loss is 0.2 db maximum and vswr (open position) is 1.0 maximum. Shutter is designed to operate under military conditions of shock, vibration (5 g at 50 to 500 cps) and temperature cycle from −40 to +100 C.

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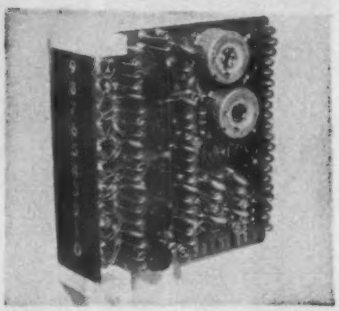

Decade Counter weighs 3½ oz

ROBOTOMICS, 4624 E. Garfield, Phoenix, Arizona. Model 1301, a 150 Kc decade counter, features an efficient binary-quinary cascaded circuit that employs only 7 transistors and operates to more than 60 C. Only a single supply voltage of +100 v at less than 3 w is required. Size is 3 9/16 in. high by 1 in. wide by 3¼ in. deep. Decade has electrical zero reset, optional coincidence output, and plugs directly into a standard 10 pin p-c connector.

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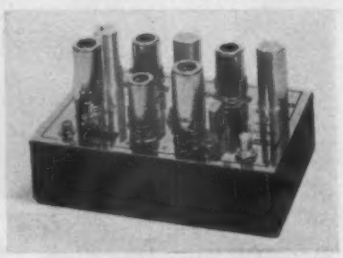


R-F Converter 460-Mc unit

CENTIMEG ELECTRONICS, 312 E. Imperial Highway, El Segundo, Calif. Model 4.6C-10 is an r-f converter

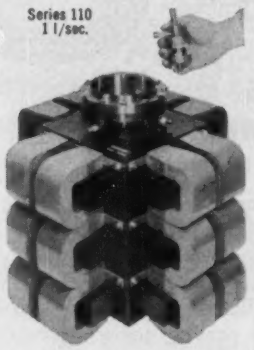
ELECTRONIC HIGH-VACUUM PUMPS

ULTEVAC®

liters per second
1
5
40
90
180
270
500
1000

THE KEY TO A TRULY CLEAN VACUUM, without fluids or other contaminants, is an UlteVac electronic pump. Can operate unattended for months or years on a sealed system; requires no traps, baffles, or refrigeration. Maintains vacuums of 10^{-9}mm Hg and below; power failure does not harm system since it is sealed after UlteVac starts. Serves as its own vacuum gauge. Operates in any position; no hot filaments, no cooling water.

Series 110
1 l/sec.



Series 327 • 270 l/sec.

ULTEK CORPORATION, only manufacturer devoted exclusively to ion pump technology, offers stock pumps 1 to 1000 liters/second capacity, plus sorption pumps, foreline traps, and SealVac fittings which provide easy-connecting rotatable flanges. Ultek invites comparison of product, service, and delivery time, on either standard or modified pumps and accessories. Literature on request—specify application.

Contact ULTEK, or its exclusive representative, Kinney Mfg. Div. of The New York Air Brake Co. Sales offices in major U.S. cities.

Booths 4309-4311 at I.R.E.

ULTEK CORP.

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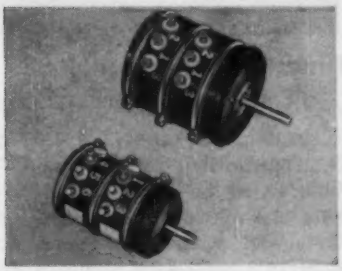
for operation in the 460-470 Mc band. Spot frequencies in the band are converted to 10.7 Mc which may be fed into standard f-m receiver i-f strips for demodulation. Guaranteed specifications are 50 db image rejection, 10 db signal plus noise to noise for 0.5 μv, 30 percent modulated a-m input, 6 db noise figure. Unit features silver-plated cavity resonators and crystal control. Input and output circuits are broadbanded to accommodate audio or video data up to 4 Mc or may be peak-tuned to improve image rejection for narrow-channel work. Units are completely shielded to comply with all FCC radiation requirements. Price is $109.50 less power supply.

CIRCLE 475 ON READER SERVICE CARD



Potentiometers conductive plastic

NEW ENGLAND INSTRUMENT CO., 1334 Main St., Waltham, Mass. Conductive plastic potentiometers models 78B (⅞ in. o-d) and 156P (1 5/16 in. o-d) are now available in multigang units to a maximum of six gangs per assembly. These are infinite resolution, long-life, low noise units and can be had in servo or bushing mounts. Units have a life expectancy of 50,000,000 revolutions. Standard units are available in 100 ohm to 10 megohm resistance value. Standard linearity is 0.5 percent; closer linearities can be readily supplied on special order.

CIRCLE 476 ON READER SERVICE CARD

Electronic Counter transistorized

EPSCO, INC., Equipment Division, 275 Massachusetts Ave., Cambridge, Mass. Model MFM-831 megacycle universal timer-counter

MASSA *Announces* 40 MM AMPLITUDE *with* RECTILINEAR INK RECORDINGS

ACTUAL REPRODUCTION ON 40 MM CHART PAPER

Portable two channel Meterite Model BSA-250

• 40 mm amplitude • Frequency Response, DC to 120 cps • Rectilinear recordings on economical ink chart paper (save more than $3000 in 200 operating hours over other rectilinear charts, running at an average chart speed of 50 mm/sec.) • Choice of interchangeable plug-in preamplifiers* • Transistorized driver amplifiers with individual power supplies • 6 Chart speeds .5 to 200 mm/sec. • Event marker with internal push button control.

MORE DATA PER DOLLAR

Eight channel recording system, Model BSA-850

• 40 mm amplitude • Frequency response DC to 120 cps • Rectilinear recordings on economical ink chart paper (save more than $6000 in 200 operating hours over other rectilinear charts, running at an average chart speed of 50 mm/sec.) • Choice of interchangeable plug-in preamplifiers* • Transistorized driver amplifiers with individual power supplies • 18 speeds push button controls .5 cm/hr to 200 mm/sec.

* **PREAMPLIFIERS** — All Massa Recording Systems are designed to accept a wide choice of plug-in Preamplifiers to satisfy every recording requirement.

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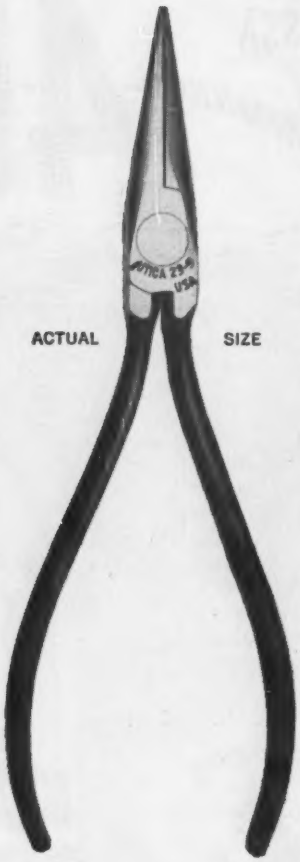


NEW MIDGET CHAIN NOSE!

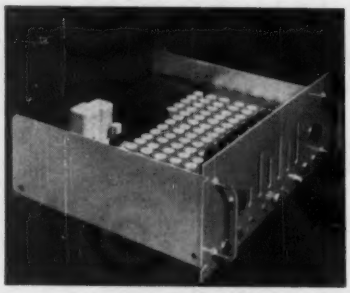
Specially designed for delicate electronic subminiature assembly, this new Utica plier is the first tool of its size and kind. Developed at the request of professionals in the electronic industry, it's a precision instrument offering the thinnest nose possible consistent with good tool design. Strong, well balanced, finely finished, it's available in 4″, 4½″ and 5″ sizes. Call your Utica distributor or write for complete information.

Utica Drop Forge & Tool Division, Kelsey-Hayes Company, Utica 4, N. Y.

tools the experts use!

is an all-transistor, militarized, high-speed frequency and time-interval instrument. It uses a count-down base requiring no adjustment. An over-regulated crystal reference provides accuracy to better than ±1 part per million ±1 count. Frequency range is 10 cps to 1 Mc. Timer range is 3 μsec to 1 msec. Data output is 6 decimal digits of 8-4-2-1 parallel binary-decimal code.

CIRCLE 477 ON READER SERVICE CARD



Time Code Generators all solid-state

ELECTRONIC ENGINEERING CO. OF CALIFORNIA, 1601 E. Chestnut Ave., Santa Ana, Calif. Two all solid-state circuit time code generators having an accuracy and stability equal to a secondary standard are designed for field instrumentation timing systems or for lab use. Outputs are suitable for recording on oscillographs, strip chart recorders, magnetic tape, or as drivers for neon flash lamps. Time-of-day code (24-hr recycling) and eight pulse rates are produced. A serial binary code is supplied as a d-c level shift and a-m carrier. The ZA-801 is a binary-coded decimal readout unit and the ZA-802 is a straight binary readout unit. Accuracy is three parts in 10^8 per day or equivalent to 1 sec per month.

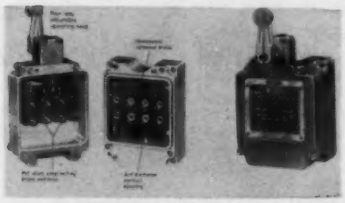
CIRCLE 478 ON READER SERVICE CARD

Capacitor metallized-paper

AEROVOX CORP., New Bedford, Mass. Type P8292ZN capacitors feature

Polycap plastic case construction and a high temperature solid impregnant. Excellent humidity resistance and improved insulation resistance characteristics are offered in these miniature capacitors. Units are completely free of any wax coating for improved appearance and ease of handling in manual and automatic assemblies. They are available in a complete range of sizes, voltages and capacitances for all applications.

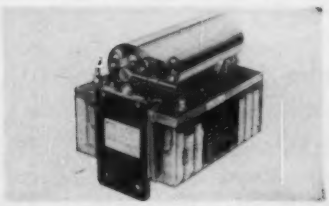
CIRCLE 479 ON READER SERVICE CARD



Limit Switch double duty

MICRO SWITCH, a division of Minneapolis-Honeywell Regulator Co., Freeport, Ill., announces a plug-in limit switch that does double duty. This capability can result in savings of time, space and wiring, and can also simplify actuating systems. Catalog 301LS1 switch actually contains two 2-circuit double-break switches which can control four isolated circuits. The roller lever actuator, when moved to the left, operates one of these basic switches, and when moved to the right, operates the other. Operating characteristics are the same in either direction. The basic switches and terminals are mounted in rugged diecast aluminum housings.

CIRCLE 480 ON READER SERVICE CARD

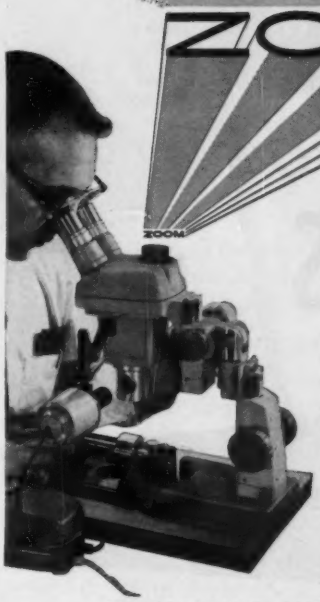


Primary Battery silver-zinc

YARDNEY ELECTRIC CORP., 40 Leonard St., Los Angeles, Calif., has developed an automatically activated

Selling FASTER than any microscope in history!

ZOOM



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A wholly enclosed optical system in a single unit. Keeps out dust and dirt; eliminates old fashioned nosepieces, annoying image jump and blackout. NEW VERSATILITY, TOO! Your choice of StereoZoom or fixed power in a Power Pod that interchanges among any of five basic stands.

NEW LOW PRICE! About ⅓ lower than previous line.

*Trademark, Bausch & Lomb Optical Co.

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61403 Bausch St., Rochester 2, N. Y.

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CIRCLE 277 ON READER SERVICE CARD

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ALLOYS

for Potentiometers and Precision Wire Wound Resistors

HOSKINS **Chromel-R**

A modified 80-20 type nickel-chromium alloy possessing optimum uniformity of all physical properties required for close tolerance electronic control applications. Possesses electrical resistivity of 800 ohms/cmf at 20°C. and a low temperature coefficient controlled within 0 ± 10 ppm/°C. Performance characteristics include remarkably low noise level plus exceptional linearity and stability from −65° to +150° C.

HOSKINS **Alloy 815-R**

A lower density, higher resistivity iron-chromium-aluminum composition that gives you 14% more ohms per pound than nickel-chromium resistor alloys. It possesses high strength, good ductility, excellent resistance to wear and corrosion. Specific resistance is 815 ohms/cmf at 20°C. and temperature coefficient is inherently controlled within 0 ± 10 ppm/°C. over the range from −65° to +150°C.

If you make potentiometers or precision wire wound resistors, these alloys are *right* for you—*right* for your customers, too. Complete technical data—the most comprehensive ever offered—are available upon request, as are sample spools of both alloys taken from current production material. Send for them today!

HOSKINS MANUFACTURING COMPANY

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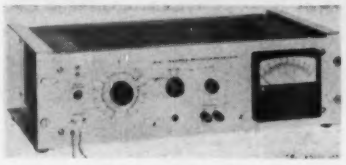
Custom-Quality resistance, resistor and thermo-electric alloys since 1908

silver-zinc primary battery that can deliver approximately 6,000 w merely seconds after activation. The Silvercel P-1517 consists of 18 cells of 20-ampere-hr nominal capacity. It weighs only 20 lb and is 500 cu in. overall. This one-shot power pack is capable of an output of 35.8 watt-hr per lb and 1.75 watt-hr per cu in. It can be activated and readied to meet specification voltages in 2 sec, and can be discharged at rates ranging from 25 amperes (at 27 v nominal for 60 minutes) to 250 amperes (at 23 v for 2 minutes). Discharge voltage is constant over a long range. Dry shelf life is 3 yr.

CIRCLE 481 ON READER SERVICE CARD



Micro-microammeter covers 17 ranges

KEITHLEY INSTRUMENTS, INC., 12415 Euclid Ave., Cleveland 6, Ohio. Model 414 measures d-c currents from 10^{-3} to 10^{-11} ampere. It is priced at $280 and is specifically designed for production tests, monitoring installations, and laboratory measurements of micro-currents. Its large, mirror-scale presents 17 ranges in overlapping 1× and 3× steps. Accuracy is within 3 percent of full scale down to 10 milliμa. Other features include: a 5-v output at up to 1 ma, output noise less than 1 percent peak to peak of full scale, a 0.2 sec response speed, and optional contact meter variations.

CIRCLE 482 ON READER SERVICE CARD

Tube Shield maximum cooling

ATLEE CORP., 47 Prospect St., Woburn, Mass., announces the redesign of its 7 pin miniature Full-Contact tube shield. New design conforms to standard socket dimensions. Both the 7-pin and 9-pin Full-Contact tube shields combine mounting ease with proven ability to withstand shock and vibration

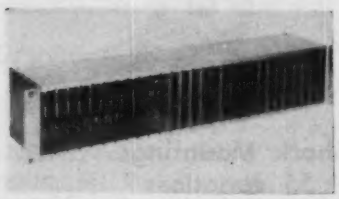
conditions. The Full-Contact line exceeds the shock and vibration requirements of MIL-19786(A), paragraph 3.6. In addition, these shields offer maximum cooling of tube envelopes. Certified copies of test reports on both vibration and cooling power of the tube shields are available upon request.

CIRCLE 483 ON READER SERVICE CARD

Frequency Converter magnetic-core

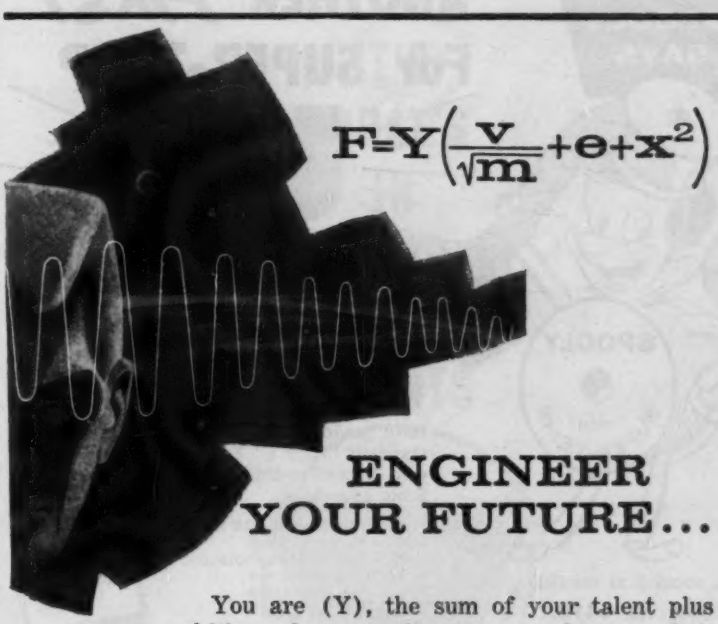
CAMBRIDGE PRODUCTS CORP., 141 Main St., Cambridge 42, Mass. Magnetic-core frequency converter is designed to convert three-phase power to either single-phase or three-phase power at a frequency which is seven times the supply frequency. Units are available in 2.5, 5, 10 and 20 Kw sizes for converting 60-cps power to 420-cps. Features: exact multiplication of input-line frequency; magnetic core components; continuously adjustable or regulated output voltage; quiet operation; wheel-mounting available.

CIRCLE 484 ON READER SERVICE CARD



Logic Blocks transistorized

CONTROL EQUIPMENT CORP., 19 Kearney Road, Needham Heights



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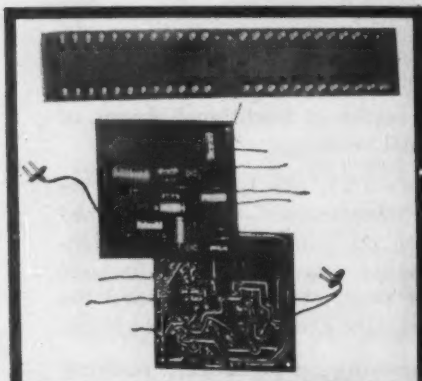

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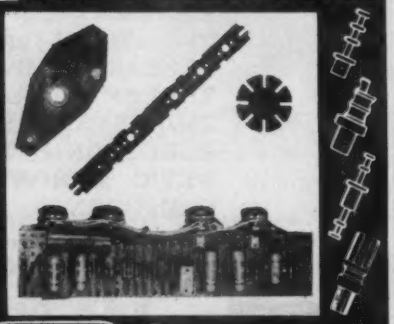

NATIONAL TEL-TRONICS CORPORATION

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One of the Nation's Largest Manufacturers of Custom Terminal Boards and Other Components for the Electronics Industry

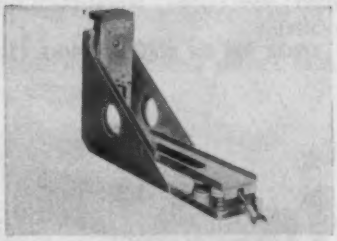
94, Mass., has a new line of compatible transistorized digital logic blocks for adding digital functions to new or existing systems and equipment. Each of the blocks is designed to perform a major digital operation. Available with either computer or panel mounting, this line of logic blocks operates within a temperature range of −45 C to +65 C. Among the features are: low power consumption, and complete compatibility between blocks. Applications include digital systems, timing and control, data processing, automation, instrumentation, test equipment and digital servos.

CIRCLE 485 ON READER SERVICE CARD

Power Supply
computer type

INVAR ELECTRONICS CORP., 323 W. Washington Blvd., Pasadena, Calif. Compact computer power supply features a fast "kill circuit". The transistorized unit cuts off all outputs in the event the current at any output exceeds a predetermined value. Supply has five outputs: ±15 v at 10 amperes, ±6 v at 5 amperes and 48 v at 1 ampere. Line and load regulation is 0.2 percent and ripple is less than 3 mv. Dimensions are 7¾ by 17 by 13 in.

CIRCLE 486 ON READER SERVICE CARD

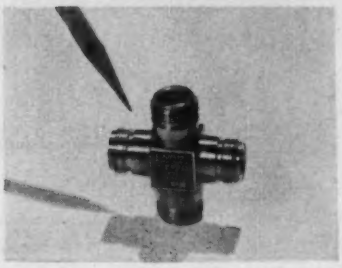


Shock Mountings
55 variations

ROBINSON TECHNICAL PRODUCTS, INC., Teterboro Air Terminal, Teterboro, N. J. All-metal mountings to isolate military or commercial airborne communications from

vibration and shock during airborne environment. The mountings come in two designs composing 55 variations. Model 2310 is a center-of-gravity system to accommodate smaller ATR configurations. Natural frequency is in 6-10 cps range with transmissibility at resonance of less than 5. Model 2311 is a base-type mount for larger ATR gear. Each mounting incorporates highly damped stainless-steel resilient elements.

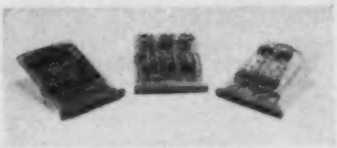
CIRCLE 487 ON READER SERVICE CARD



Power Dividers for airborne use

TRANSCO PRODUCTS, INC., 12210 Nebraska Ave., West Los Angeles 25, Calif. A complete line of miniature, lightweight power dividers for airborne application are available. Design features include broad bandwidth and low vswr. They are 50 ohm impedance, have a vswr less than 1.3 to 1, and weigh only 2½ to 4 oz. L, C, S and X bands are available—two or three-way power division. Different connector and flange types can be supplied.

CIRCLE 488 ON READER SERVICE CARD



System Module Units transistorized

SOLAR MFG. CORP., 4553 Seville Ave., Los Angeles 58, Calif., offers a range of transistorized system module units. Standard module package is a 3 by 4 p-c board designed to plug into a standard p-c connector having 2 to 15 contacts. The board is developed from 1/16 in. thick copper clad fibreglass

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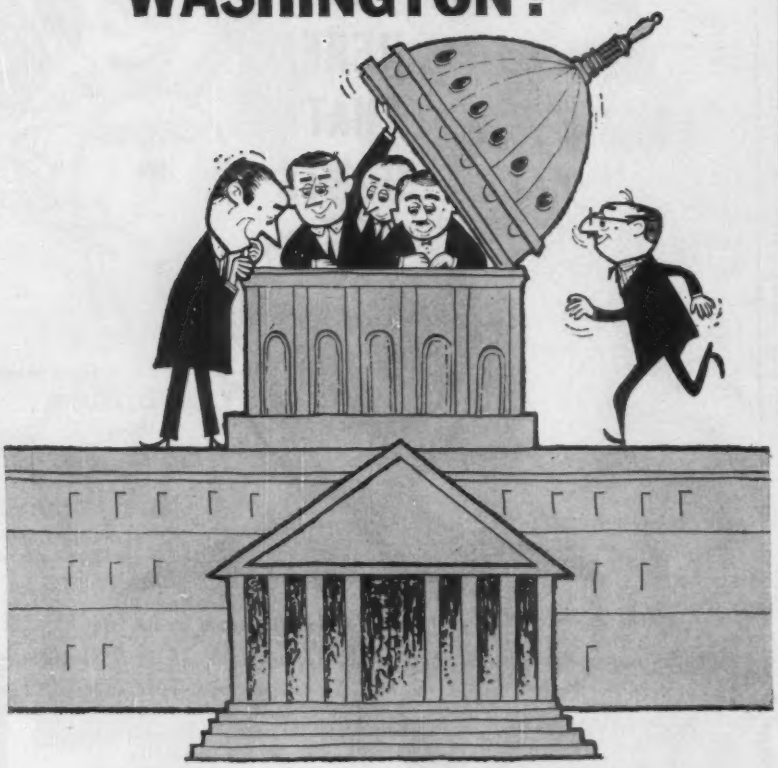
WHAT'S UP IN WASHINGTON?



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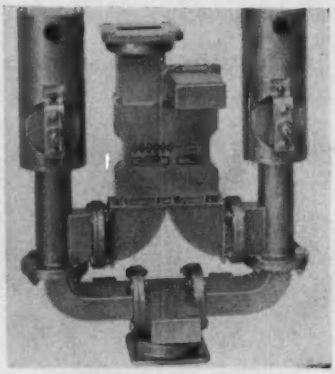
board. An indexing notch is located in the upper right hand corner for board orientation. Systems available include audio preamplifiers, muted noise amplifiers, monostable, astable, bistable multivibrators and trigger circuits, logic circuits and emitter follower amplifiers.

CIRCLE 489 ON READER SERVICE CARD



SSB Modulator
microwave ferrite

RANTEC CORP., Calabasas, Calif. Model MX200 ferrite ssb modulator produces frequency translations of the incoming signal by means of two ferrite balanced modulators whose outputs are combined in the proper phase relationships. These units produce frequency offsets up to 150 Kc with conversion losses of less than 20 db. Operation in the frequency band 9,600-10,600 Mc is possible with slight adjustments for carrier suppression. Undesired sidebands are suppressed below 20 db over a 2 percent band without adjustment. At single frequencies suppression of 50-60 db for unwanted sidebands is possible.

CIRCLE 490 ON READER SERVICE CARD

Broadband Klystrons
at L-band

LITTON INDUSTRIES, 960 Industrial Road, San Carlos, Calif. The L-3283 broadband klystrons achieve gain and power characteristics which are

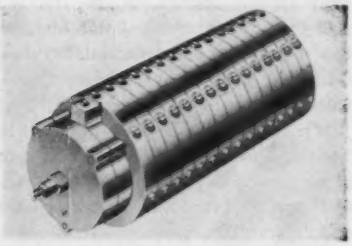
essentially flat over the minimum bandwidth of 50 Mc. Minimum peak power output at band edges is 2 mw. The tubes' linear phase shift versus frequency characteristic makes them ideal for sophisticated radar systems requiring electronic tuning and pulse shaping.

CIRCLE 491 ON READER SERVICE CARD

Test Sets high potential

ASSOCIATED RESEARCH, INC., 3777 W. Belmont Ave., Chicago 18, Ill., announces a new series of bench type, semi-portable high potential test sets with outputs to 30 Kv, for determining dielectric strength in electronic cables, components, and assemblies. Models with either a-c or d-c output are available in this series. All models provide continuously variable voltage control. Output voltage and insulation leakage current are indicated on separate meters.

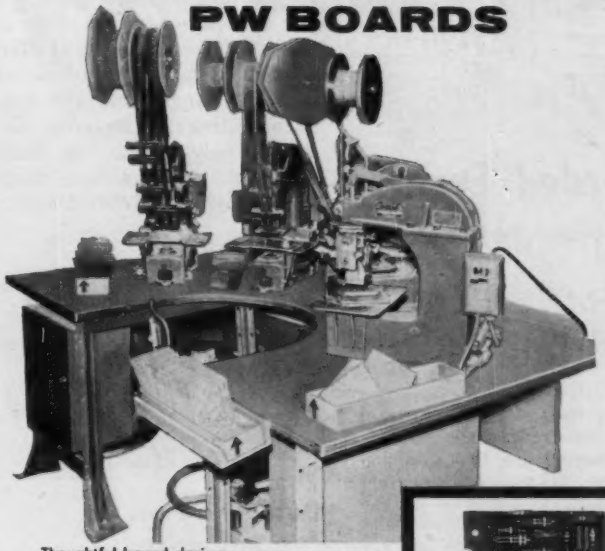
CIRCLE 492 ON READER SERVICE CARD



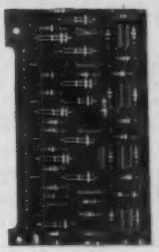
Rotary Switch lightweight

GENGE INDUSTRIES, INC., 1500 E. Colorado St., Glendale 5, Calif. Small rotary switch makes up to 100,000 contacts per minute with no contact bounce. Negligible contact resistance is obtained by a 2-lb contact pressure of coin silver against rhodium-flashed circuit ring and contacts. This construction

How to Slash Costs Assembling PW BOARDS



Thoughtful board design allows use of fixtures for high production rates and eliminates undesirable P. W. board handling.



Dynasert allows freedom in choice of body shapes and sizes.

DYNASERT® component inserting machines increase production up to 8 times over hand component inserting

Because DYNASERT machines do all these jobs — feed, trim, form leads, insert and clinch — and do it at one stroke uniformly, they can cut component inserting costs as much as 8 times compared to hand inserting. Convenient placement of bench machines in multiples can help your operators achieve maximum efficiency.

One manufacturer producing 100 boards daily found that 3,000 components could be assembled in a few hours. Savings paid for the machines in less than a year. Fully automatic lines are available which can produce up to 9,600 complete boards per shift. Work force is 1/20th of that previously required for the same volume on a hand assembly basis.

Set all types of axial lead components with highly engineered, dependable production DYNASERT Machines. Available either as a single bench mount unit or multiple unit conveyors. Send coupon today for more information about cutting costs with DYNASERT equipment.

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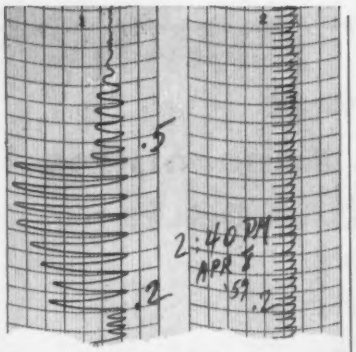

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Model WWVT

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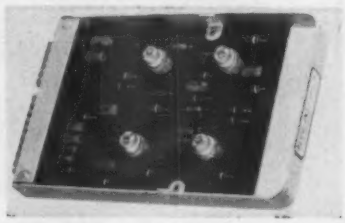
holds contact loss consistently less than 0.0003 ohm. False readings or signals are eliminated, even under acceleration of 50 g's in all 3 axes. Multiple sliding contacts reduce torque to a maximum of 1.3 in.-oz per modular wafer. A wide range of circuit arrangements is offered—1 to 101 contacts per modular wafer. Voltages range from 208 v to 1.0 v (operating). A 50-contact switch weighs only 6½ oz, and measures only 2.625 in. maximum diameter.

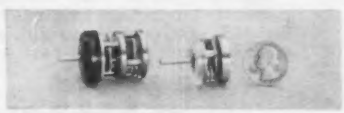
CIRCLE 493 ON READER SERVICE CARD



Dual Flip-Flop transistorized

PLUG-IN INSTRUMENTS, INC., 1416 Lebanon Rd., Nashville, Tenn. Model S-84001-PD provides two identical reset, set and trigger flip-flops. It can be used in circuits with noise levels as high as 2.5 v. Provision is made for a manual reset. Saturated circuitry is used to assure maximum reliability. Pulse repetition rates to 150 Kc with a 4 μsec resolution are standard. This low-cost circuit can be used in conjunction with other plug-in circuits and mounting hardware manufactured by the company to fabricate all types of medium speed digital or hybrid systems.

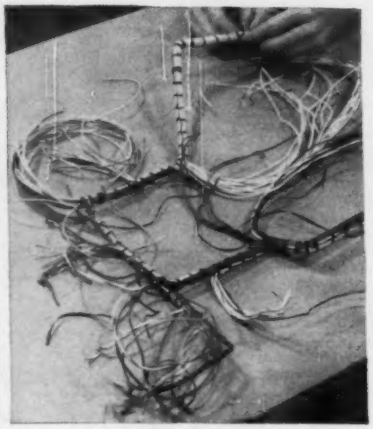
CIRCLE 494 ON READER SERVICE CARD



Gearheads precision units

U. S. GEAR CORP., 81 Bay State Rd., Wakefield, Mass., announces precision servo-motor gearheads. Planetary units are available with ratios up to 2,500:1 with a torque rating of 25 oz in. and maximum backlash of 10 minutes. Their overall length is only 0.800 in. Spur units are

GUDELACE is engineered for problem-free lacing



It's no accident that Gudelace is the best lacing tape you can buy. Excellence is *engineered* into Gudelace. A sturdy nylon mesh is meticulously combined with the optimum amount of special microcrystalline wax. Careful selection of raw materials and superior methods of combining them give Gudelace outstanding strength, toughness, and stability. Gudelace is the original *flat* lacing tape which distributes stress evenly over a wide area. It is engineered to stay flat; it will not stretch out of shape when pulled. Gudelace's nonskid surface prevents slipping, eliminating the too-tight pull that causes strangulation and cold flow. Durability and dependability make Gudelace your most economic buy—with no cut insulation, fingers, or feelings.

Write for Data Book with specifications on Gudelace and Gudebrod's complete line of braided lacing tapes and dial cords—Temp-Lace, Stur-D-Lace, and Gude-Glass.

Visit Gudebrod Booth 4025 at the IRE Show.

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BROS. SILK CO., INC.

Electronic Division
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Executive Offices
12 South 12th Street, Philadelphia 7, Pa.

CIRCLE 196 ON READER SERVICE CARD

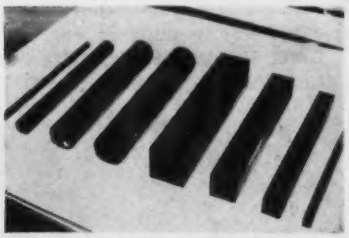
available with ratios up to 4,000:1. In the low ratio series up to 37:1 two overall lengths are offered: 0.500 in. for a torque rating of 25 oz in. and 0.609 in. for a torque rating of 50 oz in. Maximum backlash is 15 minutes. All units in the higher ratio series from 38:1 to 4,000:1 have a torque rating of 50 oz in. and maximum backlash of 30 minutes.

CIRCLE 495 ON READER SERVICE CARD

Rate Turntable
portable

STERLING PRECISION CORP., 17 Matinecock Ave., Port Washington, L. I., N. Y. Compact portable test unit for mounting rate gyroscopes, antennas, guidance assemblies and other components requiring imposition of constant rates-of-turn for spot performance checks. Model T-844 provides a single rate about a vertical axis. Modified units can be provided to furnish multiple rates, tilting to polar or horizontal axes, or with servo drive.

CIRCLE 496 ON READER SERVICE CARD



Microwave Absorber
bar stock

RADAR DESIGN CORP., 1003 Pickard Drive, Syracuse 11, N. Y. Radite No. 75 microwave absorbing plastic is designed for use as both coaxial and waveguide terminations and attenuators. It can be turned, bored, tapped, drilled, threaded or milled

FROM HEADQUARTERS

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specify H-H Blue Ribbon Space Saver Resistors. Sold through authorized H-H distributors nationwide. Call or write for catalog including both Gray Line and Blue Ribbon Resistors, MIL Types, mounting brackets and accessories. Ask for your copy, now!

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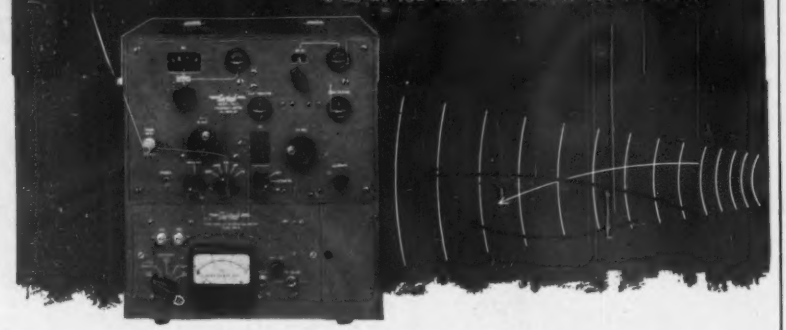
5 kc at 150 mc, or 15 kc at 450 mc max.



This portable instrument in one complete package enables you to measure both frequency and frequency deviations in the maintenance of mobile communications systems.

As optional equipment the FM-7 Frequency Meter can be combined with the new DM-3 Deviation Meter as illustrated. The DM-3 is a dual-range deviation meter with 15 kc and 7.5 kc full scales.

By combining the FM-7 and the DM-3 you get a single instrument capable of measuring and generating carrier frequencies *plus* reading peak modulation deviation.

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CIRCLE 197 ON READER SERVICE CARD

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Hermetic sealing or full encapsulation enable networks to meet applicable portions of MIL-R-93B and MIL-STD-202A.

Our Engineering Department will gladly advise the limits of accuracies and physical sizes that may be attained for your specifications.

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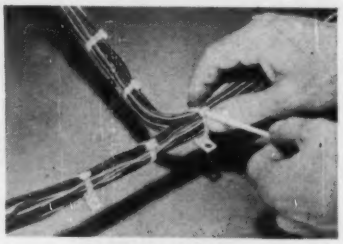
just like a metal; and it is rigid, nonporous and allows working to fine tolerances. Radite No. 75 is available in standardized 12 in. bar stock, (round: ¼ in. to 2½ in.; square; ½ in. to 2⅜ in.), and comes with detailed machining instructions. It also may be poured or molded to any configuration and size desired as a special order item.

CIRCLE 497 ON READER SERVICE CARD



Band Clamp with lock

WECKESSER Co., 5701 Northwest Highway, Chicago 46, Ill. To simplify and speed up wire, cable, tubing or hose bundling a band clamp has been developed with a separate mounting tab. The tab can be mounted in advance of wiring; therefore it is never in the way during harness assembly. Prior to locking, the tab slides around on the clamp to any desired position. Ratchet teeth on the band engage with matching teeth inside the clamp loop. The two-position floating wedge is notched and can be engaged with a rib on the inside of the loop to provide a permanent lock. Once the wedge is pushed into locked position the clamp can be released only by cutting.

CIRCLE 498 ON READER SERVICE CARD

Test Adapter for connectors

AIR-O-TRONICS ENGINEERING Co., 2210 West Ave. K-8, Lancaster, Calif., announces a test tool de-

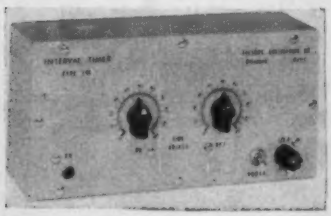
signed expressly to maintain optimum connector reliability. It is ideal for making voltage, signal, continuity and performance tests on black boxes, components, harnesses, systems, aircraft and missiles using "AN/MS", miniature, subminiature and similar type connectors. Connector reliability assured by such features as MIL Spec dimension conformance, heavy silver or gold contact plating, bendable shaft, four-way lead connection and complete insulation. Available in popular pin and socket contact sizes 20, 16, 12 and 8.

CIRCLE 499 ON READER SERVICE CARD

Silicon Rectifier double diffused

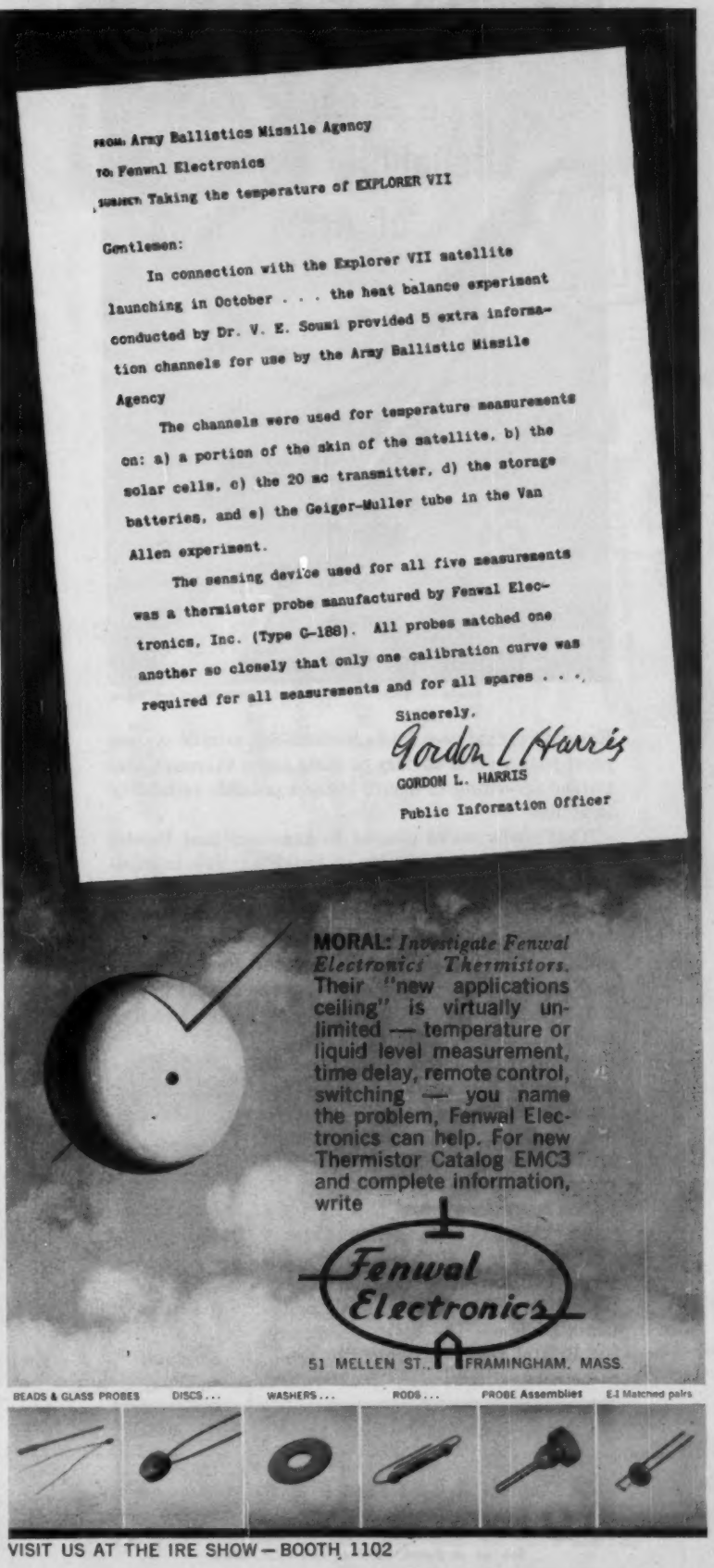
SYNTRON CO., 241 Lexington Ave., Homer City, Pa., announces style 31 double diffused silicon rectifier which is rated at 17 amperes average at 25 C ambient on a 5 in. by 5 in. by 1/16 in. copper heat sink. Peak inverse voltages range from 50 to 400 v, in 50 v steps. A typical forward dynamic resistance of 0.009 ohm is achieved by diffused junction techniques.

CIRCLE 500 ON READER SERVICE CARD



Interval Timer recycling

FELLOWS ENGINEERING CO., 1168 Meadowbrook Road, Altadena, Calif. Independently adjustable ON and


FROM: Army Ballistics Missile Agency
TO: Fenwal Electronics
SUBJECT: Taking the temperature of EXPLORER VII
Gentlemen:
In connection with the Explorer VII satellite launching in October . . . the heat balance experiment conducted by Dr. V. E. Soumi provided 5 extra information channels for use by the Army Ballistic Missile Agency
The channels were used for temperature measurements on: a) a portion of the skin of the satellite, b) the solar cells, c) the 20 mc transmitter, d) the storage batteries, and e) the Geiger-Muller tube in the Van Allen experiment.
The sensing device used for all five measurements was a thermistor probe manufactured by Fenwal Electronics, Inc. (Type C-188). All probes matched one another so closely that only one calibration curve was required for all measurements and for all spares . . .
Sincerely,
Gordon L Harris
GORDON L. HARRIS
Public Information Officer
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chopper meets reliability standards of Army "Hawk"

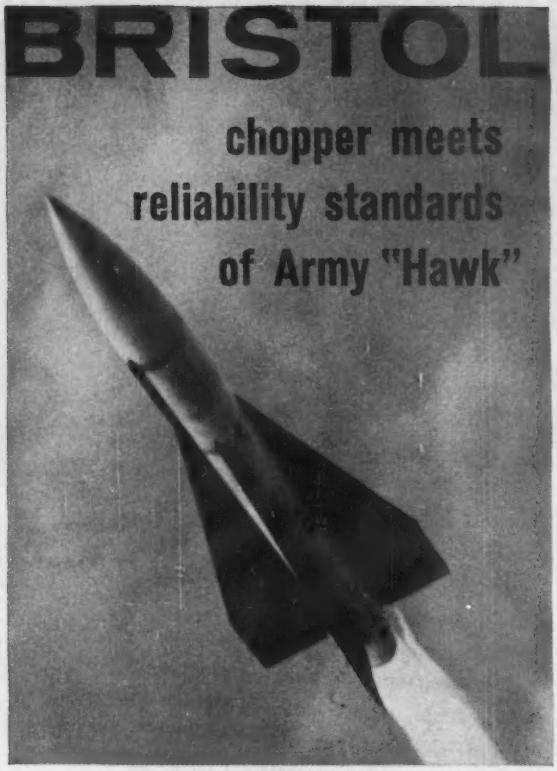

PHOTO COURTESY OF RAYTHEON COMPANY, WALTHAM, MASS.

Every part that goes into a modern-day missile system must pass a rigid battery of tests and a thorough statistical screening to insure highest possible reliability in action.

That's why we're pleased to announce that Bristol Syncroverter choppers play an important role in guidance of the U.S. Army HAWK missile, produced by Raytheon Company, Waltham, Mass., prime contractor for the complete HAWK weapons system.

Billions of operations. Bristol Syncroverter* choppers are ideal for applications requiring the utmost in statistical reliability. The Bristol life-test lab has now had miniature Syncroverter choppers running for years without failure—both with and without contact load. Just one sample: five choppers with 400-cycle drive and 12v, 1ma, resistive contact load have completed 26,000 hours (2.96 years) continuous operation—over 37-billion operations!

actual size

An extremely wide variety of standard models is available—including external coil low-noise types. For complete data, write: Aeronautical Components Division, The Bristol Company, 152 Bristol Road, Waterbury 20, Conn.

*T. M. REG. U. S. PAT. OFF. 9.26

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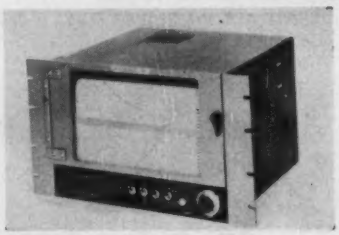
OFF time intervals are features of the type 142 recycling interval timer. Useful for the control of multipoint stepping switches in strain gage systems or temperature sampling and similar multichannel scanning systems, the unit operates within the ranges of 50 millisec to 1 sec or 1 sec to 90 sec as ordered. Output contacts are rated at 2 amperes 115 v a-c or 28 v d-c spdt. Prices range from $69.60 to $84.50 depending upon model desired.

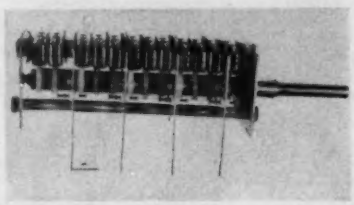
CIRCLE 501 ON READER SERVICE CARD



Strip-Chart Recorder instant selection

F. L. MOSELEY Co., 409 N. Fair Oaks Ave., Pasadena, Calif. Model 80A Autograf recorder has a full scale sensitivity of 0.05 percent and a resolution and accuracy of 0.2 percent. Its six chart speeds (2, 4, 6, 8, 15 and 60 in./min.) are selected instantly by front panel push buttons. Input range of 5 mv to 100 v is covered in 10 steps, or by vernier for completely continuous span voltage control. Input resistance is 200,000 ohms/v through 10 v, and 2 megohms on higher ranges. Instrument has a full range zero set and provides pen speeds to 0.25 sec full scale. It employs standard 120 ft chart rolls.

CIRCLE 502 ON READER SERVICE CARD



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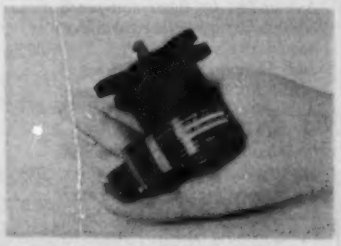
has been adapted to missile test equipment, high quality attenuators, and to other electronic assemblies. Design utilizes sensitive miniature snap-action switches which are actuated by nylon cams on the main shaft. They can be made to cover from 1 to 20 poles and can be arranged in 1, 2, 3 or 4 rows. One to 15 detent stations are available with rotation at specified degrees, the minimum being 24 deg.

CIRCLE 503 ON READER SERVICE CARD

Wirewound Pot
precision device

NEW ENGLAND INSTRUMENT CO., 1334 Main St., Waltham, Mass. Model 78 is supplied in resistance values up to 75 K ohms and a tolerance of ± 5 percent on standard units and ± 1 percent on special units. With a torque less than 0.5 in. oz per section, it will take up to 2.5 w of continuous power and meet all specifications in its range of — 55 to 150 C. It has exceptional low noise characteristics. Standard unit has a 100 megohm insulation resistance and is available in linearities down to 0.25 percent. It will meet MIL 5272 B, NAS 710 and applicable portions of JAN R-19 Standards.

CIRCLE 504 ON READER SERVICE CARD



Tach Generator
high temperature

GLOBE INDUSTRIES, INC., 1784 Stanley Ave., Dayton 4, Ohio, has developed a miniature tachometer generator for jet engine use which meets MIL-G-26611. A 2-pole 3-phase Y-connected stator and the p-m rotor furnish alternating 3-phase output power with frequency proportional to rotor velocity. Unit is capable of 14 w output at 4,200 rpm; various outputs may be specified.

CIRCLE 505 ON READER SERVICE CARD

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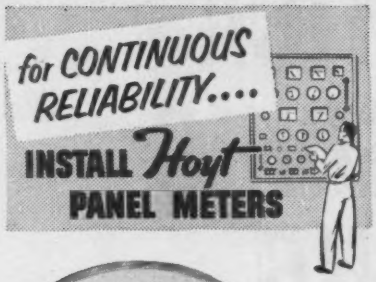
CIRCLE 291 ON READER SERVICE CARD



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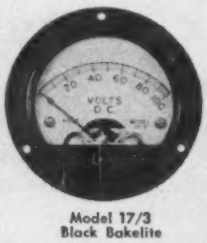

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42 Carleton St., Cambridge 42, Mass., U.S.A.

Literature of the Week

TRANSFORMERS. Chicago Standard Transformer Corp., 3501 Addison St., Chicago 18, Ill. A 36-page catalog lists over 750 transformers for industrial, communications and radio and tv applications.

CIRCLE 510 ON READER SERVICE CARD

FACILITIES BOOKLET. Technitrol Engineering Co., 1952 E. Allegheny Ave., Philadelphia 34, Pa. An 8-page booklet describes the company's background and facilities for the design and manufacture of digital components and computer and data processing systems.

CIRCLE 511 ON READER SERVICE CARD

ACCELEROMETERS. Clevite Electronic Components, 3405 Perkins Ave., Cleveland 14, Ohio. Bulletin 9503 lists prices and specifications of a new line of self-generating accelerometers.

CIRCLE 512 ON READER SERVICE CARD

R-F CONNECTORS. Automatic Metal Products Corp., 315-323 Berry St., Brooklyn 11, N. Y., has completed its radio-frequency connector guide and technical manual which presents in one volume a most comprehensive coverage of coaxial connectors.

CIRCLE 513 ON READER SERVICE CARD

MEMORY TESTER. Digital Equipment Corp., Maynard, Mass., announces a folder describing type 1512 memory tester system for testing coincident current core memories under simulated computer conditions.

CIRCLE 514 ON READER SERVICE CARD

RELIABILITY ASSURANCE. Bourns, Inc., 6135 Magnolia Ave., Riverside, Calif. A new 8-page brochure is designed to familiarize component, reliability and quality control personnel with the company's reliability assurance program.

CIRCLE 515 ON READER SERVICE CARD

SELENIUM RECTIFIERS. Radio Receptor Co., Inc., 240 Wythe Ave., Brooklyn 11, N. Y. A 4-page folder

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contains technical data on the Tri-Amp selenium rectifiers in which no artificial barrier layer is used, thus eliminating the cause of aging and high voltage drop.

CIRCLE 516 ON READER SERVICE CARD

BASIC BUILDING BLOCKS. Alden Products Co., 117 N. Main St., Brockton 64, Mass. A new brochure graphically describes the company's method of modular construction of electronic units from off-the-shelf components.

CIRCLE 517 ON READER SERVICE CARD

AUDIO BANDPASS FILTERS. Control Electronics Co., Inc., 10 Stepar Place, Huntington Station, L. I., N. Y. Data sheet 701 deals with bandpass filters designed for alternate-band separation use which have high off-passband impedances permitting inputs to be paralleled with no adverse effects on other circuitry.

CIRCLE 518 ON READER SERVICE CARD

SWITCH DATA. Newark Controls Co., 15 Ward St., Bloomfield, N. J., has available four technical data sheets which describe and illustrate two absolute air pressure switches and two gas density switches.

CIRCLE 519 ON READER SERVICE CARD

TRANSISTOR CHOPPERS. Airpax Electronics Inc., Cambridge Division, Cambridge, Md. A complete line of subminiature and miniature transistor choppers is described in bulletin C-61.

CIRCLE 520 ON READER SERVICE CARD

DATA COLLECTING SYSTEM. Friden, Inc., One Leighton Ave., Rochester 2, N. Y. A recent booklet describes Collectadata, a new data collecting system which automatically channels information from numerous work stations to a central processing point. Applications and benefits are listed.

CIRCLE 521 ON READER SERVICE CARD

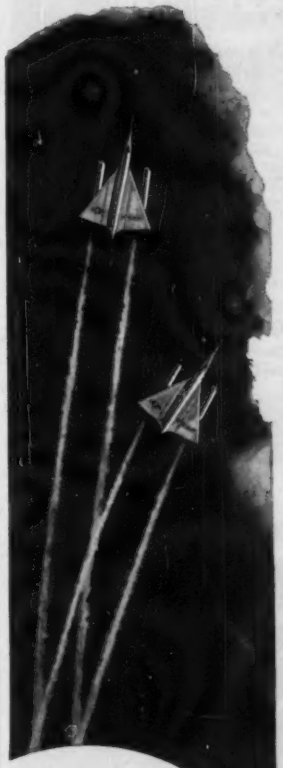
CRT's. Thomas Electronics Inc., 118 Ninth St., Passaic, N. J., has released a 6-page brochure featuring the mechanical and electrical characteristics of 165 different industrial and military crt types of the magnetic- and electrostatic-deflection variety. Brochure is de-

Airborne Time Code Generator illustrates high-density packing obtainable with T-Series circuits.

Hinged arrangement of mounting panel facilitates accessibility.

The finished package weighs only 20 lbs.; measures 5" x 8" x 20⅜". Unit generates 14-digit Point Mugu code, modulating a 1 kc carrier plus a dc time code. Three sine wave and four pulse outputs are also provided, all with only 96 T-Series circuits and 77 watts of input power.

FROM SYSTEM SPECS TO BREADBOARD TO FINISHED PRODUCT IN 75 DAYS!



That's the record set by the manufacturer of this complex airborne Time Code Generator — thanks to the compatibility of proven EECO T-Series Circuit Modules and the flexibility of the EECO Breadboard Kit.

Designed and developed for testing the fire control of manned supersonic aircraft under actual flight conditions at altitudes up to 80,000 feet, this Time Code Generator employs T-Series circuits throughout. Required accuracy of 1 part in 10^5 was easily obtained.

HIGH DENSITY, LIGHT WEIGHT

The total package contains 96 T-Series Circuits, 14 filament-type EECO Minisig Indicators, and power converters (the beginning of our line of compact 12-volt EECO Power supplies for use with T-Series circuits) — all within a volume of ½ cubic foot. In spite of this terrific packing density, the equipment still retains extreme ease of accessibility and weighs only 20 lbs. No cooling is required.

T-SERIES VS. VACUUM TUBE CIRCUITS

The use of T-Series transistorized Germanium circuits throughout resulted in great savings as against equivalent equipment designed around vacuum tube circuits. Here are some startling comparisons:

	T-SERIES	VACUUM TUBE
SIZE	800 cu. in.	8,000 cu. in.
WEIGHT	20 lbs. (including power converters)	160 lbs. (plus fan and power supply)
POWER	77 watts	650 watts (plus power for fan)

SAVE TIME AND MONEY

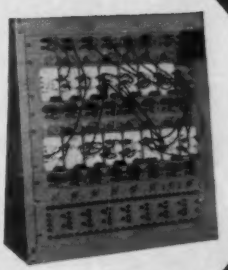
You, too, can develop the most complex equipment in record time with these proven EECO circuits and systems development aids. They'll save you time and money in four major areas:

1 **DESIGN** — You can devote full time to system design problems or unusual circuit requirements, knowing that routine circuit detail has been compatibly pre-engineered and packaged for you.

2 **BREADBOARD** — The unique EECO Breadboard Kit and plastic circuit cards enable you to set up, change, or take down experimental arrangements quickly — without waste of time or materials. Unit contains all necessary permanent wiring to accommodate any regular T-Series circuit. All other circuit inter-connections are made by patch cords or plugs, with prepunched circuit cards to guide you.

3 **PRODUCTION** — Your production problem is reduced to one of mounting sockets on panels or chassis and providing simple socket-to-socket wiring. Plug in the appropriate circuits and the system is complete.

4 **CHECKOUT**—The extreme reliability of T-Series circuits eliminates the need for circuit "debugging." Checkout time is reduced to a bare minimum.



EECO Breadboard Kit.

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signed so that it can be conveniently used as a wall chart.
CIRCLE 522 ON READER SERVICE CARD

COAX TERMINATIONS. Weinschel Engineering, 10503 Metropolitan Ave., Kensington, Md. Bulletin 235-1/60 contains specifications and prices for precision coaxial terminations, models 535, 803 and 804, with type N connectors.
CIRCLE 523 ON READER SERVICE CARD

STATIC MULTIPLE POWER SUPPLY. Magnetic Amplifiers, Inc., 632 Tinton Ave., New York 55, N. Y. New static inverter-converter supply designed to operate off 28 v d-c and provide 3 phase 3,200 cps power at 1 Kva, with additional outputs at 300 v d-c and 150 v d-c for a total of 1,300 va is described in bulletin S-1057.
CIRCLE 524 ON READER SERVICE CARD

SILICON DIODES. Silicon Transistor Corp., Carle Place, L. I., N. Y., has available a new bulletin with technical data for seven silicon glass diodes manufactured to conform to military specifications.
CIRCLE 525 ON READER SERVICE CARD

AUTOMATIC WAVE ANALYSIS. Minneapolis-Honeywell Regulator Co., 10721 Hanna St., Beltsville, Md. New 16-page bulletin DB 9050a describes and illustrates automatic wave analysis, a versatile engineering tool for Fourier and spectral power studies.
CIRCLE 526 ON READER SERVICE CARD

SILICONE PRODUCTS. General Electric Co., Silicone Products Department, Waterford, N. Y. A 1960 guide to GE's complete line of silicone products is now available in an 8-page illustrated bulletin.
CIRCLE 527 ON READER SERVICE CARD

CAPACITOR BULLETIN. Sprague Electric Co., North Adams, Mass. Bulletin 2110A fully describes subminiature Vitamin Q and stabilized wax metal-clad paper capacitors.
CIRCLE 528 ON READER SERVICE CARD

INTERFERENCE FILTERS. Infrared Industries, Inc., P. O. Box 42, Waltham 54, Mass. Perform-

ance characteristics and other features of four basic types of infrared interference filters are described in a 4-page brochure.

CIRCLE 529 ON READER SERVICE CARD

VOLTAGE DIGITIZERS. Adage, Inc., 292 Main St., Cambridge 42, Mass. Important engineering data and performance specifications of 8 basic Voldicon voltage digitizers are described in a 6-page short form catalog.

CIRCLE 530 ON READER SERVICE CARD

PHASE SEQUENCE RELAYS. Master Specialties Co., 956 E. 108th St., Los Angeles 59, Calif. Bulletin 2001 covers 18 standard phase sequence relays which offer automatic monitoring of three phase power.

CIRCLE 531 ON READER SERVICE CARD

MAGNETIC MODULATORS. General Magnetics Inc., 135 Bloomfield Ave., Bloomfield, N. J., has published a bulletin describing Mag Mod miniaturized magnetic modulators which are designed for subminiature circuit assemblies and p-c card configurations.

CIRCLE 532 ON READER SERVICE CARD

TRANSFORMERS. Sorensen & Co., Inc., Richards Ave., South Norwalk, Conn. Product data sheet AC140 covers three models of regulated plate and filament transformers.

CIRCLE 533 ON READER SERVICE CARD

VOLTAGE DIVIDER CALIBRATION. Electro Scientific Industries, Inc., Portland, Ore. "Design Ideas" is the name of a new four-page two-color technical publication to be issued quarterly. First issue is devoted to detailed discussion of voltage divider accuracy and calibration.

CIRCLE 534 ON READER SERVICE CARD

SAMPLING RELAYS. James Electronics Inc., 4050 N. Rockwell St., Chicago 18, Ill. Catalog sheet covers the new line of Micro-Scan relays designed for d-c, asynchronous and synchronous switching of extremely low microvolt level to moderate level signal circuits such as found in digital, analog and measurement applications.

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International IRE

PLANTS AND PEOPLE

McFarlan: for IRE, interplay

LAST TUESDAY, the new president of the Institute of Radio Engineers sandwiched in a private celebration among visits to chapters of the IRE in the Southeast and meetings at the New York headquarters. It was his 55th birthday, and it may be his last quiet moment in a busy year.

The organization which Ronald L. McFarlan now heads has become the world's largest engineering society, with many electronics engineers and scientists numbered among its 80,000 members. The organization's growth is underscored by the fact that this year, for the first time, it has two vice presidents, one in North America and the other in England.

One sign of IRE's maturity is the increasing interest of members and officials alike in cross-pollination with other engineering societies. The Institute's board of directors chose well in picking McFarlan to guide it through a year of experimenting with increased intersociety exchange. The tall Ohioan—whose barely contained energy gives him the appearance of being animated by springs—is a member of four other engineering fraternities*, besides having been a senior IRE member since 1951.

He's deeply conscious of the twin needs to increase contact with other groups and to educate the public to a sound understanding of the engineer's importance in the community. The two campaigns will absorb a lot of his time during the coming year.

McFarlan, a researcher and engineering manager turned consultant, went to the University of Cincinnati (his home town), then switched to the University of Chicago, where he received his Ph.D. in physics in 1930. For two years afterward he was a National Research Council Fellow in physics at Harvard, then spent three years on the faculty there.

Early work in X-ray diffraction and ultraviolet spectroscopy was followed by interest in microwave techniques, radar and sonar, instrument design, computers and navigation systems. He moved from posts as chief physicist at United Drug and the B. B. Chemical Co. through the directorship of research at Bulova Watch Co. to Raytheon Mfg. Co. For eight years he was executive assistant to Raytheon's director of equipment engineering. That company and its offspring Datamatic Corp. (sired also by Minneapolis-Honeywell, which now is sole owner) are two of the big accounts in his consulting firm's portfolio.

*American Physical Society, American Chemical Society, Institute of the Aeronautical Sciences, and the American Society of Naval Engineers—not to mention Sigma Xi.

Engineers Set For Convention

A COMPREHENSIVE 54-session program has been arranged for the 1960 IRE International Convention on March 21-24 in New York City. Thirty-three sessions will be held at the Waldorf-Astoria Hotel and 21 at the New York Coliseum. (In listing the program, locations are referred to as WA and C, respectively.) An attendance of 60,000 engineers and scientists is expected.

Highlighting the technical program will be a special symposium on Tuesday evening, March 22, in which the nation's leading experts will discuss the future of space electronics.

The full program of papers and authors follows:

Monday Afternoon
March 21

1. Control Theory (WA)

Incremental Phase Plane Analysis of Nonlinear Sampled Systems, by J. A. Aseltine and R. A. Nesbit, Space Technology Laboratories, Inc.

On the Existence and Uniqueness of the Optimal Multivariable Systems Synthesis, by M. D. Mesarovic, Case Institute of Technology.

On Optimal and Suboptimal Policies in the Choice of Control Forces for Final-Value Systems, by M. Aoki, U. of Calif.

A Study of Asynchronously Excited Oscillations in Nonlinear Control Systems, by O. I. Elgerd, U. of Florida.

On the Optimum Synthesis of Sampled Data Multipole Filters with Random and Nonrandom Inputs, by H. C. Hsieh and C. T. Leondes, U. of Calif.

2. The Brookhaven Alternating-Gradient Synchrotron; Transistorized Nuclear Instrumentation (WA)

The Brookhaven Alternating-Gradient Synchrotron

Part I—Alternating Gradient Synchrotron, by J. P. Blewett, Brookhaven National Laboratory.

Part II—The Linear Accelerator Injector for the AGS, by S. D. Giordano, Brookhaven National Laboratory.

Part III—Radio-frequency Accelerating System for the AGS, by M. Plotkin, Brookhaven National Laboratory.

Transistorized Radiation Monitoring Equipment, by J. J. Henry, Union Carbide Nuclear Co.

A Sensitive Parametric Modulator for D-C Measurements, by R. R. Hoge, Bendix Aviation Corp.

Semiconductor Synchronous Clamp for Millivolt Signal Levels, by A. J. Koll, E. Bleckner and O. C. Srygley, Aero Geo Astro Corp.

3. The Engineer Writes and Speaks (WA)

How to Edit Your Own Papers, by Eleanor McElwee, RCA.

Basic Concepts of Increased Effectiveness in Oral Presentations, by I. J. Fong, Remington Rand Univac.

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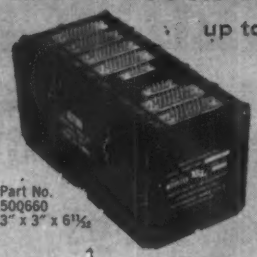

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Shock	100g, 10 millisecs, sawtooth, six directions
Acceleration	45g for 2 seconds in six directions
Service Free Life	200 hours guaranteed; 500 hours expected
Insulation Resistance	100 megohms at 300 volts d.c.
Hi Potential Test	500 volts, 60 cycle a.c., 1 min. each lead to ground

Complete specifications and drawings available on Technical Bulletin No. 500660

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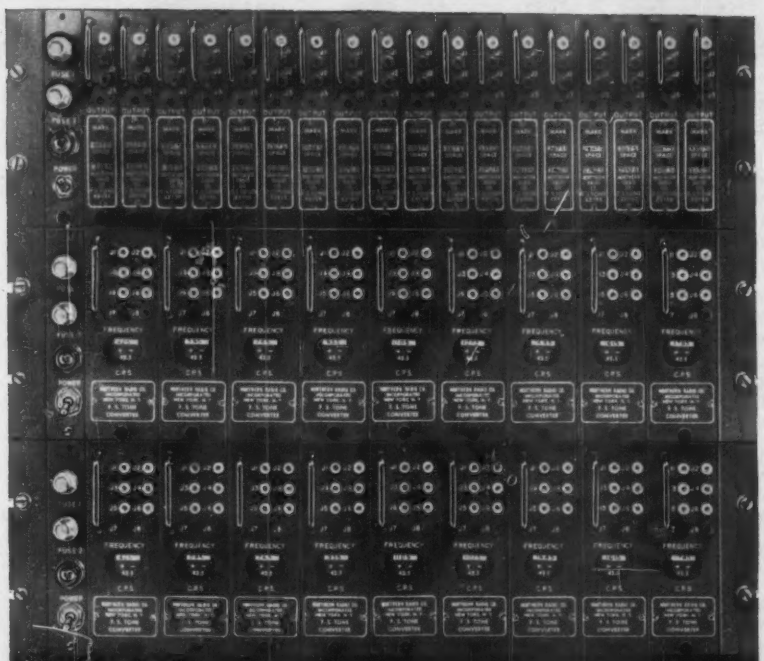

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Preparation, by N. J. Smith, IBM.

The Paper Reader at Conventions Will Soon Be Obsolete, by J. O. Reece, Texas Instruments, Inc.

4. Radio Frequency Interference (WA)

Simulation Tests on an Interference Rejection Antenna System, by W. D. White and C. O. Ball, AIL.

Computer Simulation of Signal Environments, by W. G. James, AM&F Co.

Wiring of Data Systems for Minimum Noise, by J. V. White, Beckman/Systems Div.

Receiver Analysis for Interference Prediction Purposes, by D. C. Ports, Jansky & Bailey; C. R. Miller and John Savage, Rome Air Development Center.

Electromagnetic Interference and Vulnerability Reduction, by J. J. Egli, US Army Signal R&D Lab.

Fire Fighting or Fire Prevention, by L. A. Yarbrough and J. W. Worthington, Jr., Griffiss AFB, N. Y.

5. Engineering Management—I (WA)

Management and the Employee-Owned Concept of Young R and D Growth Firms, by D. M. Kruchko, Aero Geo Astro Corp.

An Engineering Management View of the Maintainability Problem, by M. J. Marcus, IBM.

Engineering Management for Creative Appraisal of New Ideas—The Secret Weapon for Technical Progress?, by W. H. Beaubien, GE.

How to Produce Reliable Products at a Profit, by C. W. Watt, Raytheon Co.

Concepts of Capital Financing for Electronic Companies, by R. T. Silberman, Electronics Capital Corp.

6. Advances in Aerospace Subsystems (C)

Range Ambiguity Resolution in High PRF Radar, by N. S. Potter, The W. L. Maxson Corp.

An Ion Altimeter for Pressure-Altitude Measurements, by G. V. Zito, Bendix Aviation Corp.

The Nature of Astro Doppler Velocity Measurement, by J. E. Abate, Kearfott Co., Inc.

Generation of Artificial Electronic Displays with Application to Integrated Flight Instrumentation, by G. H. Balding, Kaiser Industries; and Charles Susskind, U. of Calif.

The Synchro-Magnetic Approach and Terminal Landing System for Aircraft, by Ross Gunn, The American University.

7. Production Techniques (C)

Fabrication and Interconnection of Micro-Circuits Applicable to Data Processing Equipment, by J. E. Richardson and J. W. Burkig, Hughes Aircraft Co.

Ultrasonic Welding of Electronic Components, by W. C. Potthoff, C. F. DePrisco and W. N. Rosenberg, Aeroprojects Inc.

A Disquisition of the Innovations and Gadgetry Used in the Volume Production of a Super Power Electron Device, by J. A. Jolly, Eitel-McCullough, Inc.

Design and Manufacturing of a Simplified Grid Module, by Leon Jacobson, GE.

Micromodule Components: A Review of the State of the Art, by R. A. Felmly, RCA.

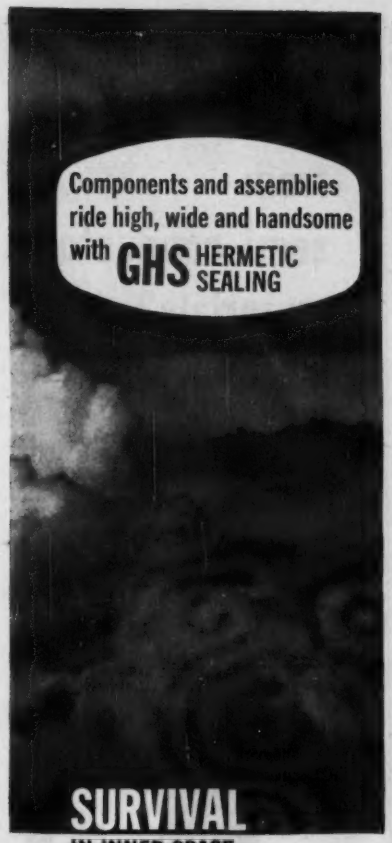
8. Electronic Devices (C)

Rating Power Transistors for High Current Pulses, by Peter Balthasar, Bendix Aviation Corp.

An NPN Fusion Alloy Silicon Transistor for "Avalanche Mode" Operation, by R. C. Wonson and W. A. McCarthy, Raytheon Co.

Photoconductor Optical Encoders for In-Line Readout Devices, by Carl Isborn, Beckman/Berkeley Div.

Advances in Screen Structure and Data Distribution for the ELF Display System, by E. A. Sack, Westinghouse Research Labs.



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Shadow Grid VHF RF Tuner Tubes, by F. R. Snyder and C. D. McCool, GE.

Focus-Reflex Modulation for Electron Guns, by Kurt Schlesinger, GE.

Tuesday Morning
March 22

9. Control Applications (WA)

Decoupling Techniques in Multi-Loop Control Systems, by R. H. Loomis, Westinghouse Electric Corp.

Optimum Compensation of a Position Servo with a Magnetic Clutch Actuator, by R. J. Hruby, Northrop Corp.

Synthesis of a Self Adaptive Autopilot for a Large Elastic Booster, by G. W. Smith, The Martin Co.

Design of Optimum Beam Flexural Damping in a Missile by Application of Root-Locus Techniques, by R. J. Hruby, Northrop Corp.

Flywheel Control of Space Vehicles, by J. E. Vaeth, The Martin Co.

10. Direct Conversion (WA)

Thermoelectric Converters, by Kurt Katz, Westinghouse Electric Corp.

Thermionic Converters, by Walter Grattidge, GE Research Lab.

Noble-Gas Plasma-Diode Thermionic Converter, by F. E. Jamerson, General Motors Research Labs.

Magnetohydrodynamic Approaches, by R. J. Rosa, Avco-Everett Research Lab.

Direct Conversion—Where Do We Stand?, by R. J. Pidd, General Dynamics Corp.

11. Broadcasting—I (WA)

Report on Geneva Radio Conference, by W. H. Watkins, FCC.

Future Possibilities for Film Room Mechanization, by J. H. Greenwood, WTAE-TV and WCAE-AM/FM.

Directional Antennas for Television Broadcasting, by G. H. Brown, RCA.

Service Area of an Airborne Television Network, by M. T. Decker, National Bureau of Standards.

12. Audio (WA)

A Plotter of Intermodulation Distortion, by E. F. Feldman, Panoramic Radio Products, Inc.

Listener Ratings of Stereophonic Systems, by H. B. Moore, GE.

Calculation of the Gain-Frequency Characteristic of a Multi-Mesh Transistor Amplifier Stage Using a Programmed Computer, by D. E. Brinkerhoff, Delco Radio Div., General Motors Corp.

Automatic Compensation of an Audio System Spectrum Operating with a Random Noise Input, by C. E. Maki, MB Electronics.

An Analysis of Factors Affecting Recording Reliability and Digital Tape Recorders, by Ken Taylor, Ampex Corp.

13. Engineering Management—II (WA)

More Effective Engineering Proposals—One Key to Success, by F. W. Evans, Jr., Office of Naval Materiel.

The Application of Closed Loop Control Techniques to Engineering Project Planning and Control, by R. W. Haine and W. Lob, Bendix Aviation Corp.

The Professional Register—A Program for Improving Engineering Management Visibility of Technical Capabilities, by N. A. Begovich, Hughes Aircraft Co.

Management Control of Engineering Effort through Graphic Methods, by B. P. Gollomp, Bendix Aviation Corp.

14. Varied Views of Medical Electronics (C)

Introductory Remarks—Training of Medical Engineers, by H. H. Zinsser, New York City.

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Automatic Measurement of Enzyme Activity, by D. I. Weinberg, Astra, Inc.

Biological Microwave Hazards, by V. T. Tomberg, Biophysical Research Lab.

An Automatic Physiological Telemetry and Analog-to-Digital Conversion System, by W. E. Sullivan, Airborne Instruments Laboratory; J. T. Farrar, Veterans Administration Hospital; and C. A. Steinberg, Airborne Instruments Laboratory.

Panel: Significant Variables in Biophysical Evaluation of the Human under Stress

Members: Charles D. Ray, U. of Tennessee; Leland Clark, Medical College of Alabama; Members of the Staff of Col. John P. Stapp, Wright-Patterson AFB; and Otto H. Schmitt, U. of Minnesota.

15. Modern Approaches for Improved Air Traffic Management (C)

An Air Height Surveillance Radar (AHSR-1), by T. J. Simpson, Federal Aviation Agency.

Automatic Ground-Air-Ground Communications for Control of Air Traffic, by W. R. Deal, Federal Aviation Agency.

Technical Research for Future Aviation Facilities, by Nathaniel Braverman, W. W. Felton, Simon Justman, R. E. Kester, L. J. Schaub and Arthur Wetter, Federal Aviation Agency.

A Mathematical Analysis of the Performance of the ATC Radar Beacon System, by A. Ashley and F. H. Battle, Jr., Airborne Instruments Laboratory.

16. Broadening Device Horizons (C)

Masers, by J. W. Meyer, MIT.

Variable Reactance Devices, by B. Salzberg, Airborne Instruments Laboratory.

Tunnel Diodes, by H. S. Sommers, Jr., RCA.

Functional Devices, by W. A. Adcock, Texas Instruments, Inc.

Tuesday Afternoon
March 22

17. Radar and Coding Theory (WA)

Sequential Procedures in Radar Pre-Tracking, by Mischa Schwartz, Polytechnic Institute of Brooklyn.

Detection Range Predictions for Pulse Doppler Radar, by S. A. Meltzer and S. Thaler, Hughes Aircraft Co.

The Search Efficiency of the Sequential Probability Ratio Search Radar, by G. W. Preston, General Atronics Corp.

Group Codes for Correcting Prescribed Error Patterns, by R. T. Chien, IBM.

Some Results on Best Recurrent-Type Binary Error-Correcting Codes, by W. L. Kilmer, Montana State College.

18. Industrial Electronic Instrumentation (WA)

An inquiry into the Computer Automation of Supermarkets, by R. R. Segel, Thompson Ramo Wooldridge, Inc.

Automatic Testing and Calibration of Central Air Data Computer, by H. Langenthal, Bendix Aviation Corp.

Electronics in Agriculture, by F. C. Jacob, U. of California.

The Shawmeter—An Electronic Two-Color Pyrometer, by V. G. Shaw, Shaw Instrument Corp.

19. Broadcasting—II (WA)

Some Engineering Aspects of Video Tape Recording Production, by E. E. Benham, KTTV, Inc.

A Modern TV Transmitter Plant Input System, by J. L. Stern, CBS-TV Network.

A Special Effects Amplifier for Non-Composite or Composite Monochrome or Color TV Signals, by R. C. Kennedy, NBC.

Remote Control of TV Microwave Equipment, by J. B. Bullock, RCA.

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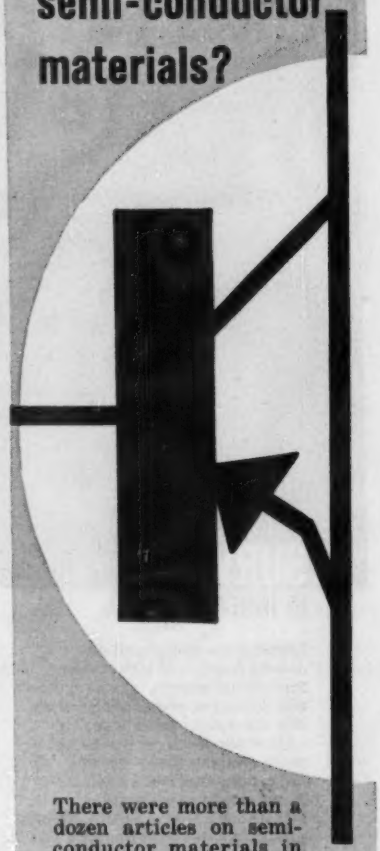

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20. Audio and Broadcast and Television Receivers (WA)

The Present Status of Stereo Broadcasting, by C. G. Lloyd, GE.

Receiver Design Considerations for Stereophonic FM Multiplex Broadcasting, by C. G. Eilers, Zenith Radio Corp.

The Percival Stereophonic Sound System, by W. S. Percival, Research Laboratories of Electric & Musical Industries, Ltd., England.

A Continuously Variable Wireless Remote Control for Stereophonic Phonographs, by A. A. Goldberg and Arthur Kaiser, CBS Laboratories.

Automatic Stereophonic Phaser, by B. B. Bauer, A. A. Goldberg and G. Pollack, CBS Laboratories.

21. The Human as Originator of Signals and Schemes (C)

Implantable Cardiac Pacemakers, by Wilson Greatbatch, Electronics Consultant, Clarence, N. Y.

Detection and Analysis of HF Signals from Muscular Tissues with Ultra Low Noise Amplifiers, by W. K. Volkers, Cohu Electronics; and William Candib, St. Claire Hospital, Schenectady, N. Y.

Stereo Dynamic Aspects of Fetal Auscultation and Its Application to Medical Diagnosis, by F. D. Napolitani, Mt. Vernon, N. Y., and L. E. Garner, Jr., Silver Springs, Md.

Use of a High Sensitivity Capacitance Pickup in Heart Sound Research, by Dale Groom and Y. T. Sihvonen, Medical College of South Carolina.

Panel: Discussion of Human Factors in Electronic Design Leslie Kaeburn, U. of Southern Calif., Walter Tolles, Airborne Instruments Laboratory, and Edward Llewellyn-Thomas, Defence Research Medical Labs., Canada.

22. Design of Equipment Reliability (C)

Safety Margins Established by Combined Environmental Tests Increase Atlas Missile Component Reliability, by C. C. Campbell, Convair Astronautics.

Segregating Subsystem Errors of a Transistor Magnetic Circuit, by W. R. Kuzmin, Packard Bell Electronics Corp.

The Statistical Analysis of Redundant Systems, by Fred Moskowitz, Rome Air Development Center.

Some Results of an Early Reliability Program, by R. E. Kuehn, IBM.

Maintainability Profile Analysis, by H. E. Thomas, J. Soukup and W. Brobst, ITT Laboratories.

23. Microwave Tubes (C)

High Power CW X-Band Amplitron, by W .C. Brown, Raytheon Co.

High Power L Band CW Traveling Wave Tube Amplifiers, by R. Strauss and J. McCammon, Sperry Electronic Tube Division.

The Effects of Magnetic Focusing Fields and Transverse Beam Velocities on Spurious Oscillations in Backward-Wave Oscillators, by L. L. Maninger, Sylvania Products, Inc.

The Design and Performance of a Commercial Ammonia Maser Oscillator, by S. Hopfer, Polytechnic Research & Development Co., Inc.

Extended-Dynamic-Range Traveling-Wave Tubes, by J. Kliger and E. J. Downey, Hughes Aircraft Co.

Tuesday Evening
March 22

24. Electronics—Out of This World (WA)

Inter-galactic Data, by Lloyd V. Berkner, Associated Universities, and Morris Tepper, NASA.

Weather Forecasting and Control, by Luis

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Communication Relaying, by Jerome B. Wiesner, MIT.

Wednesday Morning
March 23

25. Detection Theory and Applications to Physics (WA)

Estimation of Doppler Shifts in Noise Spectra, by Peter Swerling, The Rand Corp.

Optimum Coincidence Procedures for Detecting Weak Signals in Noise, by Jack Capon, Federal Scientific Corp.

A General Theory of Signal-to-Noise Ratio Improvement, with Application to the Visual Detection of Weak Signals, by N. S. Potter, W. L. Maxson Corp.

Information Rates in Photon Channels and Photon Amplifiers, by T. E. Stern, Columbia U.

An Aspect of Information Theory in Optics, by Hideya Gamo, IBM.

26. Broadcast and Television Receivers (WA)

Reduction of Modulation Defocussing in Television Picture Tubes, by Joseph Hoehn, Allen B. DuMont Laboratories, Inc.

Recent Developments in Scan Magnification, by N. Parker, I. Csorba and N. Frihart, Motorola, Inc.

Noise Figure Performance of VHF Transistors and Tubes at Various Operating Conditions, by J. F. Bell and L. E. Matthews, Zenith Radio Corp.

A New High Performance AM/FM Transistorized Portable Receiver, by B. J. Miller and E. A. Snelling, Zenith Radio Corp.

Filter-Phaser AM Stereophonic Receiver, by A. A. Goldberg and Arthur Kaiser, CBS Laboratories.

27. Electronic Component Parts (WA)

An Evolution Is Coming, by Richard Dewitt, DSDD R&E.

Tomorrow's Technology—Functional Electronic Blocks, by W. S. Heavner, Wright-Patterson AFB.

Electronic Progress—Circa 1960, by L. J. D. Rouge and G. M. R. Winkler, Ft. Monmouth, N. J.

The Thermionic Integrated Micro-Module Program, by C. G. Childs, A. P. Haase, M. W. Hamilton and R. M. Hughes, GE.

Microcircuitry—A Practical Technology for Reliable Microminiaturization, by F. P. Granger, Jr. and J. G. Smith, Varo Mfg. Co.

28. Space Telemetry (WA)

A Versatile Data Processing Facility, by J. P. Randolph, Johns Hopkins U.

Evaluation of Modulation Methods for Telemetry Usage, by M. Rudin and D. Childers, Aeronutronic Div. of Ford Motor Co.

Conceptual Design of a General Purpose Telemetry System, by W. F. Link, Aeronutronic Div. of Ford Motor Co.

Detection Levels and Error Rates in PCM Telemetry Systems, by A. V. Balakrishnan and I. J. Abrams, Space Technology Labs., Inc.

A Highly Precise FM/FM Telemetering Device, by H. K. Schoenwetter, Hoover Electronics Co.

29. Seminar on 1959 ITU Geneve Conferences (WA)

30. Communication Systems Design (C)

Equipment Configuration and Performance Criteria for Fully Optimized Tropospheric-Scatter Systems, by C. A. Parry, Page Communications Engineers, Inc.

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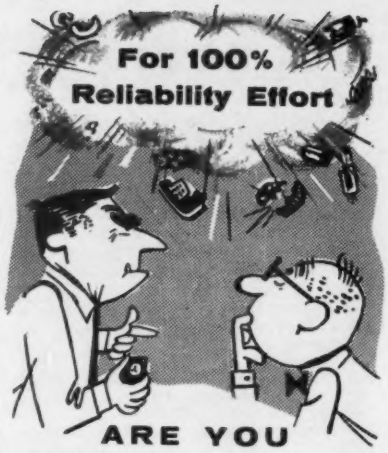

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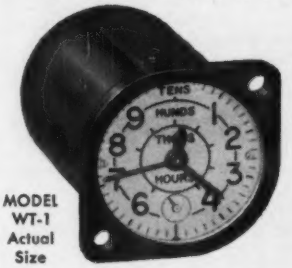

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Simple Methods for Designing Tropo-Scatter Circuits, by L. P. Yeh, Page Communications Engineers, Inc.

Optimized SSB Transmitter Loading by Multi-Channel Frequency Division Data, by A. T. Brennan and J. P. Daly, Stromberg Carlson Div. of General Dynamics; and Bernard Goldberg, US Army Signal R & D Lab.

"Quicksilver" A Long Range General Purpose Digital Communications System, by A. C. Chapman, Hughes Aircraft Co.

31. Aspects of Component Reliability (C)

The Reliability of Components Exhibiting Cumulative Damage Effects, by George Weiss, U. S. Naval Ordnance Lab.

Statistical Models for Component Aging Experiments, by Joan Rosenblat, National Bureau of Standards.

Statistical Approach to Reliability Improvement, by N. P. Demos, GE.

Quality Acceptance Measures—ADL vs AQL, by G. V. Herrold, Sylvania Electronic Tubes Div.

Accelerated Environmental Testing of Automotive Electronic Components, by F. R. Kahn, Delco Radio Div., General Motors Corp.

32. Microwave Filters (C)

Band-Pass Microwave Filter Design—A New Method and Its Relation to Other Methods, by G. L. Matthaei, Stanford Research Institute.

Optimum Quarter-Wave Transformers, by Leo Young, Westinghouse Electric Corp.

Magnetically Tunable Microwave Filters Employing Single Crystal Garnet Resonators, by P. S. Carter, Jr., Stanford Research Institute.

Harmonic Calorimeter for Power Measurements in a Multimode Waveguide, by V. G. Price, GE.

Wednesday Afternoon
March 23

33. Electronic Computers and Circuit Theory; How Each Technology Can Help the Other (WA)

Switching and Memory Criterion in Transition Flip-Flops, by D. O. Pederson and D. K. Lynn, U. of Calif.

Monte Carlo Analysis of Transistor-Resistor Logic Circuits, by Y. C. Ho and W. J. Dunnett, Sylvania Electronic Systems.

An Analog Computer Nyquist Plotter, by E. A. Goldberg, Space Technology Labs., Inc.

Smoothing and Prediction of Time Series by Cascaded Simple Averages, by R. B. Blackman, Bell Telephone Labs., Inc.

Synthesizing Minimal Stroke and Dagger Functions, by John Earle, IBM.

34. Ultrasonics Engineering—I (WA)

Eigen Coupling Factors and Principal Components, The Thermodynamic Invariants of Piezoelectricity, by H. G. Baerwald, Sandia Corp.

Piezomagnetic Ceramic Transducers, by O. E. Mattiat, Curtiss-Wright Corp.

An Ultrasonic Power Source Utilizing a Solid State Switching Device, by W. C. Fry, Westinghouse Electric Corp.

Ultrasonic Cleaning Tests For a Variety of Driving Waveforms, by R. C. Heim, Westinghouse Electric Corp.

The Effectiveness of Ultrasonic Degreasing as Measured by Radiotracer Techniques, by E. L. Romero and H. A. Stern, RCA.

A Spaced Lamination Transducer For Industrial Use, by E. B. Wright, Westinghouse Electric Corp.

An Efficient Low-Cost Ultrasonic Transducer For Use in Remote Control and Carrier Frequency Applications, by Frank Massa, Cohu Electronics, Inc.

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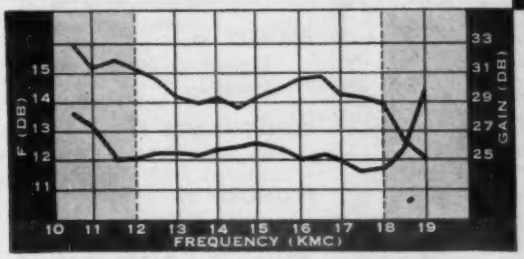

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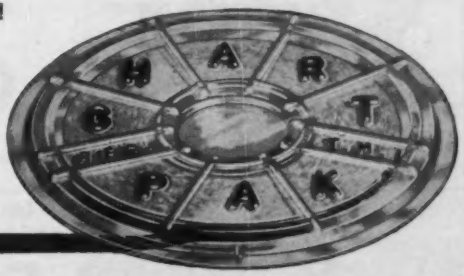

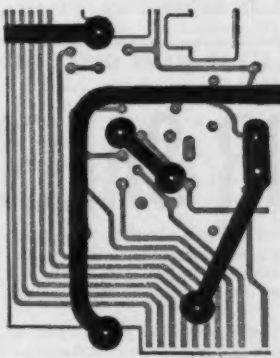

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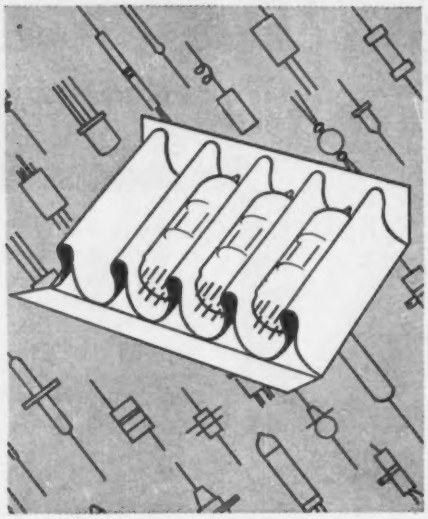

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35. Component Parts (WA)

Magnetostrictive Ultrasonic Delay Lines for a PCM Communication System, by D. Aaronson and D. B. James, Bell Telephone Laboratories, Inc.

The Reliable Application of Electronic Component Parts, by H. L. Dudley, Melpar, Inc.

The Transient Effect in Capacitor Leakage Resistance Measurements, by R. W. France, Hughes Aircraft Co.

Dynamic Temperature Coefficient of Micro-Element Inductors, by G. Hauser, RCA.

A New Automatic Method for the Design of Low Voltage Transformers on the IBM 704, by D. A. Franks, Westinghouse Electric Corp.

36. Stereophonic Sound Reproduction (WA)

Stereophonic Sound Reproduction, by H. F. Olson, RCA Laboratories.

Psychoacoustics of Stereophonic Reproduction, by R. L. Hanson, Bell Telephone Laboratories, Inc.

Some Considerations in Design and Application of a Compatible Magnetic Tape Cartridge, by Marvin Camras, Armour Research Foundation of Illinois Institute of Technology.

A 1⅞ IPS Magnetic Recording System for Stereophonic Music, by P. C. Goldmark, C. D. Mee and W. P. Guckenburg, CBS Laboratories.

Automated Magnetic Tape Cartridge Mechanisms, by J. D. Goodell, CBS Laboratories.

37. Communication System Techniques (C)

Analysis of a Phase Modulation Communications System, by R. L. Choate, California Institute of Technology.

An Improved Decision Technique for Frequency Shift Communications Systems, by Elmer Thomas, Page Communications Engineers, Inc.

High Sensitive Receiving Systems for Frequency Modulated Wave, by Masasuke Morita and Sukehiro Ito, Nippon Electric Co., Ltd., Japan.

An Improved Multiplex Voice Frequency Carrier System, by Bernard Tennent, Philips Electronics Industries, Ltd., Canada.

Model of Impulsive Noise for Data Transmission, by Pierre Mertz, Long Beach, N. Y.

38. Antenna Pattern Synthesis (C)

Panel Members: R. C. Spencer, The Martin Company; P. A. Bricout, Litton Industries; and Robert Bickmore, Hughes Aircraft Co.

Derivative Control in Shaping Antenna Patterns, by A. Ksienski, Hughes Aircraft Co.

Some New Methods of Analysis and Synthesis of Near-Zone Fields, by Ming-Kuei Hu, Syracuse U.

Synthesis of $CSC^2\theta$ Type Antenna Patterns Using Two-Dimensional Surface Wave Arrays, by H. W. Cooper and H. R. McComas, Westinghouse.

Determination of Optimum Primary Feed Ellipticity Setting to Obtain Circular Polarization from Reflector Type Antennas, by L. J. Kuskowski, Airborne Instruments Laboratory; and A. M. McCoy, Raytheon Mfg. Co.

39. Microwave Interaction with Matter (C)

Panel Members: Professor S. C. Brown, MIT; C. L. Hogan, Motorola; and H. Kroemer, Varian Associates.

Recent Progress in Microwave Beam, Plasma and Solid State Devices, by L. M. Field, Hughes Aircraft Co.

Microwave Interaction with Plasmas, by R. G. Buser and P. Wolfert, US Army Signal R&D Lab.

A New Semiconductor Microwave Modulator, by Harold Jacobs, F. A. Brand and Michael Benanti, US Army Signal R&D Lab., and Richard Benjamin, Monmouth College.

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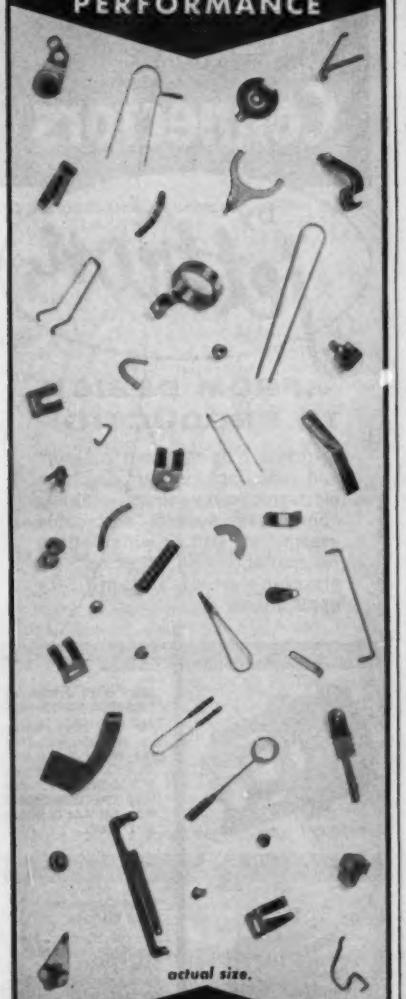

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Thursday Morning
March 24

40. Adaptive Networks (WA)

Pattern Recognition with an Adaptive Network, by Lawrence Roberts, MIT.

On Predicting Perceptron Performance, by R. D. Joseph, Cornell Aeronautical Laboratory, Inc.

The Mark 1 Perceptron—Design and Performance, by J. C. Hay, F. C. Martin and C. W. Wightman, Cornell Aeronautical Laboratory, Inc.

A Magnetic Integrator for the Perceptron Program, by J. K. Hawkins, Aeronutronic Systems, Inc.

41. Circuit Theory: Current Contributions (WA)

Transfer Function Synthesis of Active RC Networks, by E. S. Kuh, U. of Calif.

Broad-Band UHF Distributed Amplifiers Using Band-Pass Filter Techniques, by F. C. Thompson, HRB-Singer, Inc.

A Fourier Series Time Domain Approximation, by D. R. Anderson, Hughes Research Labs.

Spectral Measurements of Sliding Tones, by Will Gersch and J. M. Kennedy, Columbia U.

An Approach to the Synthesis of Linear Networks Through Use of Normal Coordinate Transformations Leading to More General Topological Configurations, by E. A. Guillemin, MIT.

42. Ultrasonics Engineering—II (WA)

The Measurement of River Flow by the Use of Underwater Sound, by G. E. Miller, W. F. Richardson and N. Serotta, Raytheon Co.

Ultrasonic Flowmeter, by H. Dahlke and W. Welkowitz, Gulton Industries, Inc.

Optical Studies of Delay Line Transducers, by R. F. Weeks, Richard D. Brew & Co., Inc.

Ultrasonic Delay Line Analysis, by D. L. Schilling and A. N. Silver, Columbia U.

A Comparison of Several Dispersive Ultrasonic Delay Lines Using Longitudinal and Shear Waves in Strips and Cylinders, by A. H. Fitch, Bell Telephone Labs., Inc.

Physical Principles and Operational Characteristics of Variable Ultrasonic Delay Lines, by Walther Andersen, Andersen Laboratories, Inc.

New Techniques in Ultrasonic Delay Lines, by D. L. Arenberg, Arenberg Ultrasonic Lab., Inc.

43. Equipment and Systems (WA)

Missile Master (AN/FSG-1)—System Functional Description, by George Romano, D. L. Prentice and James Hayne, The Martin Co.

Missile Master (AN/FSG-1)—System Equipment Description, by Ralph Staschke and Douglas Noden, The Martin Co.

Weather Radar Data Processing, by O. Lowenschuss, Budd Lewyt Electronics, Inc.

A Building-Block Approach to Multi-Purpose Communication Equipment, by L. G. Fobes and J. E. Martin, US Army Signal R&D Laboratory; and H. A. French, W. L. Glomb and M. W. Green, ITT Laboratories.

An Integrated Approach to the Design of Mobile Tactical Electronic Systems, by R. N. Skalwold, Rome, N. Y. and M. N. Scheiderich, Rome, N. Y.

Electronic Equipment Weight and Volume Penalties to Flight Vehicles, by W. V. White, Collins Radio Co.

44. Satellite Communications (WA)

Radio Relaying by Reflection from the Sun, by D. J. Blattner, RCA Laboratories.

Active Versus Passive Satellites for a Multi-Station Communication Network, by L. Pollack and D. Campbell, ITT Laboratories.

Satellite Communication Problems and Solutions in Ground Station Design, by W. L.

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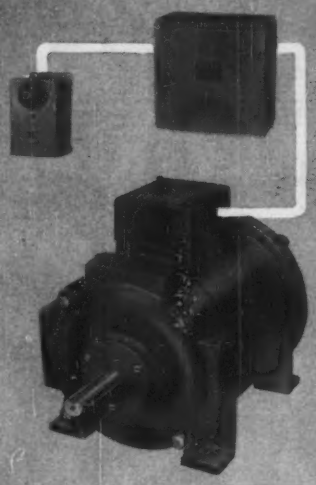

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Detail Design of an Operational Missile Voice Frequency Communications System, by W .S. Cayot, Nortronics.

A Digital Data Handling System for Real-Time Computation on the Atlantic Missile Range, by M. P. Falls, RCA Service Co., and T. A. Christie, Jr., Stanford U.

45. Human Factors in Electronics (C)

Coding Equipment for Ease of Maintenance, by J. H. Ely, Dunlap Associates.

The Replaceable Component: Key to Maintainability, by R. B. Miller, IBM.

A Procedure for Predicting Reliability of Man-Machine Systems, by P. C. Berry and J. J. Wulff, Psychological Research Associates, Inc.

A Method for Anticipating Human Factors Requirements in Manned Weapon Systems, by M. A. Grodsky, The Martin Co.

46. Scanning Antenna Arrays (C)

Panel Members: John Ruze, Radiation Engineering Laboratory; Harold Shnitkin, The W. L. Maxson Corp.; and A. E. Marston, Naval Research Laboratory.

An Electronically Scanned Circular Antenna Array, by H. P. Neff and J. D. Tillman, The U. of Tennessee.

Multidirectional Antenna—A New Approach to Stacked Beams, by Judd Blass, The W. L. Maxson Corp.

Parasitic Spiral Arrays, by R. M. Brown, Jr., and R. C. Dodson, U. S. Naval Research Lab.

An Electromechanically Scannable Trough Waveguide Array, by W. Rotman, AF Cambridge Research Ctr., and A. Maestri, Melpar, Inc.

47. Magnetic Recording (C)

The Effects of Track Width in Magnetic Recording, by D. F. Eldridge and Albert Baaba, Ampex Corp.

Erased Carrier Recording, by W. J. Murphy, Oliver-Shepherd Industries, Inc.

Reliability and Drop-Out Studies for Long-Playing Loops, by Al Wilson, Precision Instrument Co.

Digital Magnetic Recording with High Density Using Double Transition Method, by Andrew Gabor, Potter Instrument Co., Inc.

Automatic Error Detection Equipment for Digital Tape Recorders, by G. J. Slusarchyk, T. D. Radway and Paul Heller, Airborne Instruments Laboratory.

Thursday Afternoon
March 24

48. Electronic Computers (WA)

An On-Line Solid State Analog Computer for Automatic Gas Flow Compensation, by F. P. Simmons, Link Aviation, Inc.

Very High Density Digital Magnetic Recording, by D. E. Killen, Oliver-Shepherd Industries, Inc.

A Tunnel Diode Tenth Microsecond Memory, by M. M. Kaufman, RCA.

Automatic System and Logical Design Techniques Used on the RW-33 Computer System, by T. A. Connolly, Ramo-Wooldridge.

Logical Design Features of the LARC System, by W. F. Schmitt and L. F. Harrison, Remington Rand Univac.

49. Symposium on a Decade of Progress in Network Theory (WA)

Graph Theory and Electric Networks II, by Frank Harary, U. of Michigan.

Physical Realizability Criteria, by D. Youla, Polytechnic Institute of Brooklyn.

Some Properties of Time Varying Networks, by J. M. Manley, Bell Telephone Labs., Inc.

Application of Synthesis Techniques to Electronic Circuit Design, by F. H. Blecher, Bell

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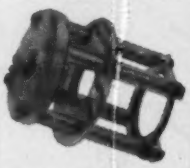

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50. Space Electronics (WA)

A Broad Band Spherical Satellite Antenna, by H. B. Riblet, Johns Hopkins U.

A Pulsed Plasma Mechanism for Propulsion in Space, by P. M. Mostov, J. L. Neuringer and D. S. Rigney, Republic Aviation Corp.

Design Considerations of Television Satellite Reconnaissance Systems, by R. L. Zastrow and D. J. Ritchie, Bendix Aviation Corp.

Scanning Methods for Satellite-Borne Radars, by A. Rosenfeld and O. Lowenschuss, Budd-Lewyt Electronics, Inc.

A Study of Natural Electromagnetic Phenomena for Space Navigation, by R. G. Franklin and D. L. Birx, The Franklin Institute.

51. Check-Out Instrumentation and Circuitry (WA)

Trends in Complex Weapon Systems Check-Out, by F. C. Corey, Northrop Corp.

The Role of Multipurpose Automatic Test Systems in Testing Integrated ABNMGS Systems, by I. H. Rubaii, IBM.

Selecting the Optimum Test Interval for Static Alert Systems, by F. L. Paulsen and L. Mast, Packard Bell Electronics.

Rapid Detection of Coherent Signals in Noise, by R. J. Metz, J. M. Walker and N. L. Weinberg, Westinghouse Electric Corp.

Determination of Repetition Frequencies of Intermixed Pulse Trains, by R. J. Kern, RCA.

Coherent Enhancer for Pulse Radar Application, by E. Brookner and J. Flink, Federal Scientific Corp.

52. Vehicular Communications (C)

Past and Future Techniques of Vehicular Communication, by E. W. Chapin, FCC.

Radio Coverage—Area Survey—Instrumentation Research, by C. E. Sharp and R. E. Lacy, US Army Signal R&D Laboratory.

Cryptographic Signaling Applied to Radio Communication Circuits, by O. E. Thompson, Secode Corp.

Highway Alert Radio, by E. A. Hanysz, General Motors Corp.

A New Colinear Antenna Array, by A. H. Secord and W. V. Tilston, Sinclair Radio Laboratories, Ltd., Canada.

53. Antenna and Propagation Problems (C)

Spiral Antenna Systems, by R. Bawer and J. J. Wolfe, Aero Geo Astro Corp.

A Monopulse Cassegrainian Antenna, by L. Schwartzman and R. W. Martin, Sperry Gyroscope Co.

Power-Handling Capability of Antennas at High Altitude, by W. E. Scharfman and T. Morita, Stanford Research Institute.

Propagation Measurements in Shock-Ionized Media, by D. E. Sukhia and G. H. Hampton, The Martin Co.

Ultra-Low Frequency Atmospherics, by Herbert Gonig, Electro-Physical Institute of the College of Technology, Munich, Germany.

Ray Tracing for Whistler-Mode Signals at Low Frequencies, by E. R. Schmerling, Pennsylvania State U., R. Goerss and S. Miluschewa, and P. Hertzler and I. Pikus, RCA.

54. Waveform Analysis and Random Vibration (C)

A Time-Compressor Using Magnetostrictive Delay Lines, by S. J. Meyers, L. Rosenberg and A. Rothbart, ITT Laboratories.

Utilization of The Quadrature Functions As A Unique Approach to Electronic Filter Design, by Henry Paris, Rixon Electronics, Inc.

A Magnetostrictive-Filter Random Wave Analyzer, by Richard Boynton, M B Electronics.

A Numerical Method for Determining The Vibration Acceleration Density Directly from The Sinusoidal XY Plot, by W. Reich and

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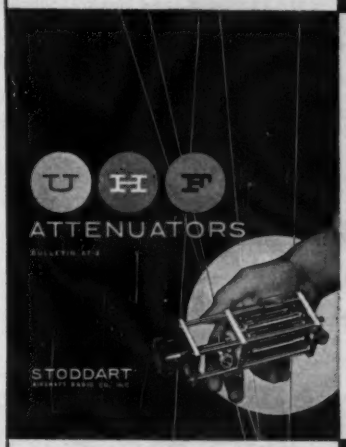

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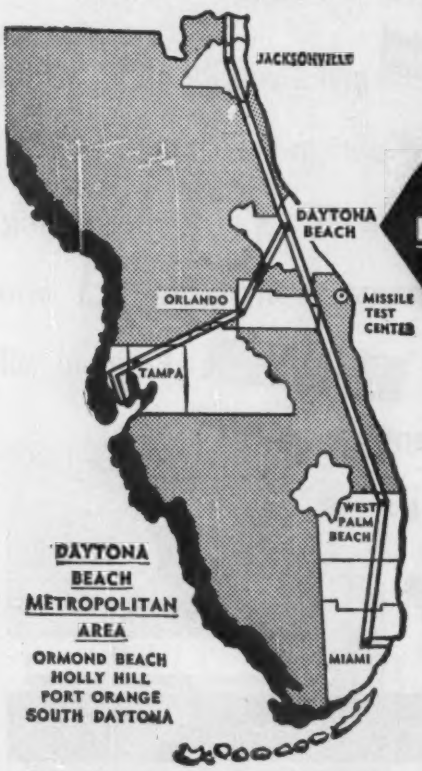

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A New Approach to Random Vibration Control Instrumentation, by W. W. Caldwell, Ling-Altec Electronics, Inc.

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264VAC 210VDC	$6.00	7.50	9.00	10.50	13.50	16.50	18.00	24.00	30.00	34.50	40.00	51.00	62.00	72.00	83.00	103.00	124.00	154.00	185.00	206.00	247.00	308.00	370.00	412.00	494.00
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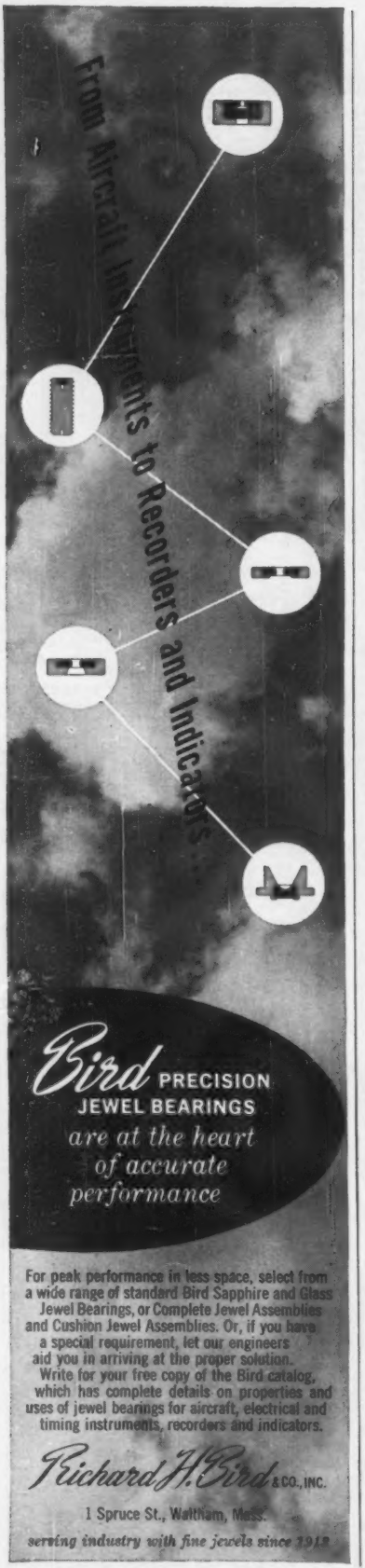
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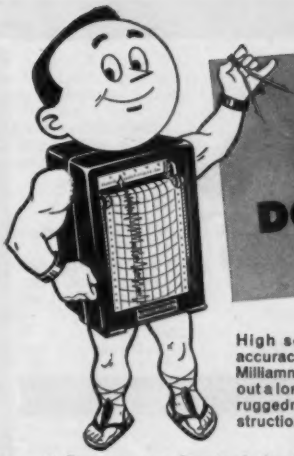

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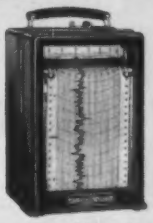

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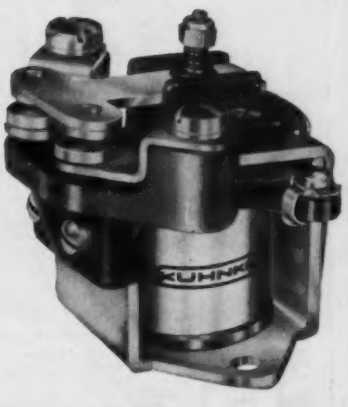

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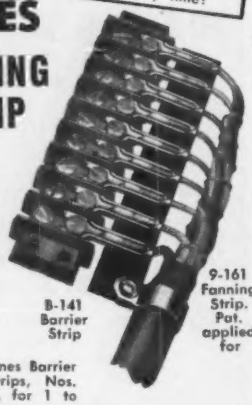

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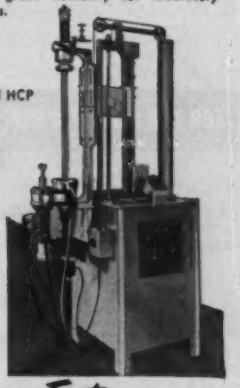

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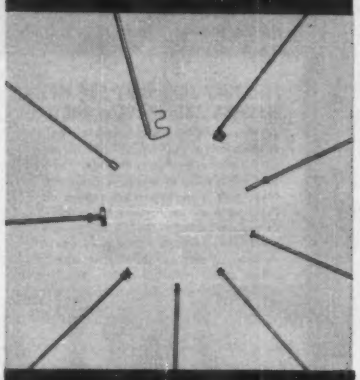

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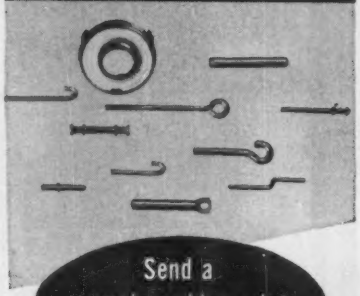

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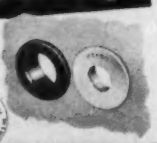

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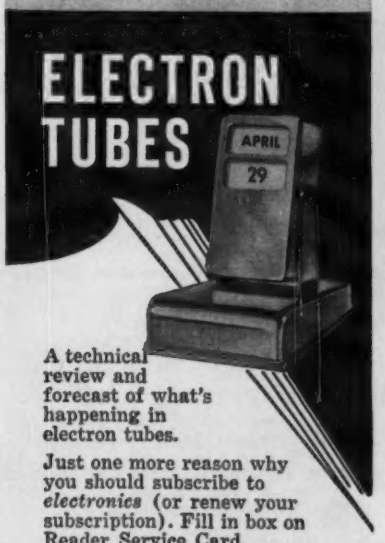

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DYNATRAN ELECTRONICS CORP., Mineola, N. Y., recently appointed Erwin M. Wolf as chief engineer. He was formerly a project engineer with the Reeves Instrument Corp. where he specialized in transistorized analog and digital computer projects.

In his new post, Wolf will be responsible for the development of the company's standard line of quality semiconductor test instruments as well as custom instruments and transistorized products.

News of Reps

Instruments for Industry, Inc., Hicksville, N. Y., designer and manufacturer of automatic countermeasures equipment, communications systems and special purpose amplifiers, has appointed two new sales reps:

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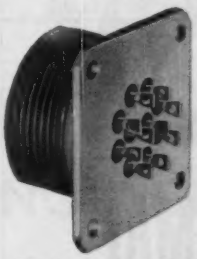

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BACKTALK

Payola Probes

Anent the Washington Outlook column in ELECTRONICS (p 14), Feb. 19, mostly covering the Congressional investigations of radio station and network operations—the "Payola Probes".

It is indeed disturbing to think that it might be necessary to allocate the power of some sort of censorship to the FCC or some other Federal agency—but even more disturbing is the fact that some sort of control must be established, in view of the general misuse of public airwaves.

Once upon a time, radio and tv programs were generally of good quality, but now look and listen to the mess! You never hear one spot announcement at a time anymore, it's always at least three in a row, usually five on tv shows. Closing commercial, a spot, station ID with a plug, another spot, and then the opener commercial for the following program. It is not unusual for the more unscrupulous station operators to throw in a couple of more spots encroaching on network time. I wonder what correlation could be made between water consumption and time during these strings of commercial spots. The argument can't be used that the stations are giving the public what they want, as few of the "public" watch commercials willingly. Admittedly, the spots are the livelihood of the broadcast and tv industry—but they could stand no end of improvement. I remember reading, somewhere in "Title 47: Telecommunications," that buried in the verbiage and tv channel assignments is a paragraph indicating that "all broadcast and tv stations be operated in the public's interest." We don't need any new laws or regulations: we simply need a couple of our Representatives to give the FCC a nudge in the right direction, supply them with the necessary funds, and let them enforce that section of the regulations. I think most people would like to see a modification of the Rules and Regulations to allow FCC to suspend any radio station's license for varying lengths of time for infractions of the Rules, not only for too "commercial" an opera-

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tion or too much rock-and-roll-and-wise-guy-disk-jockey shows, but for the common technical faults found in many of the smaller plants operating either remote control or with an announcer with a Restricted Permit at the throttle.

Most of the "coffee pots" I have heard seem to go by the idea that "if 100 percent modulation is good, 110 percent is better," and their signal splatters over the top half of the band. Many stations occupy a far greater portion of the spectrum than they are entitled to simply because they do not limit their upper modulation frequencies to something less than 10 kc. In the days of old-style recordings, it didn't make much difference if there was a filter between the console and the transmitter—there wasn't much above about 5 or 6 kc on the recordings, but today's records are far better with frequencies present to 20 kcs or so.

It seems to me that these fundamental infractions of the rules need policing with a firm hand, too. I can think of no better incentive for the few odd-balls in the broadcast and tv industry to straighten up and fly right than the knowledge that the FCC can and will take them off the air for a couple of weeks and has the people necessary to make the checks and investigations necessary. . . . . Radio might offer a few good programs for a change, and tv might bring us something besides Westerns.

We can get good entertainment back in our homes again by backing the FCC and asking our Representatives to give the FCC the funds necessary to bring their operations up to date. I understand that their budget is still about as it was 10 years ago, while radio and tv stations have multiplied like rabbits. You can't get the all-day parkers off Main street without a good police force. . . . No broadcaster in his right mind is going to let some grey flannel-suited expert tell him how to run his station, if he knows that the FCC can call him on it and give him 24 hours to explain how his present programming is "in the best public interest" or suffer suspension for a week or two.

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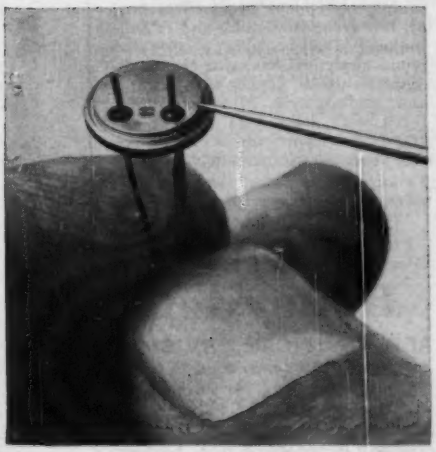

IBM semiconductor specialists have developed this all-diffused NPN germanium mesa transistor which has a frequency cutoff greater than 600 megacycles.

The basis for this development is a process in which a mask of silicon monoxide permits the diffusion of desired "N"-type elements into regions of minute dimensions. This new device, designed for high-speed switching applications, has also been made possible by important advances in germanium "P"-type diffusion processes achieved by IBM engineers and scientists.

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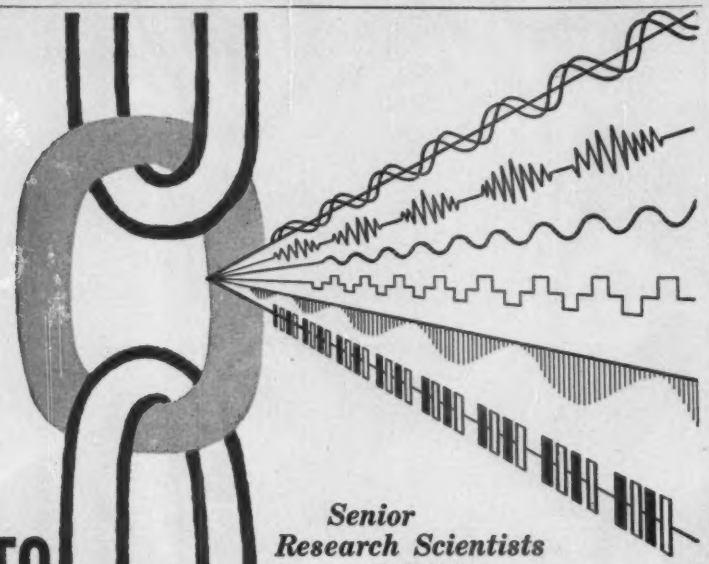

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Electronics Engineer with a minimum of 5 years' experience, with thorough knowledge of single sideband theory and its application. Should possess a complete understanding of AM, FM, PM and single sideband modulation processes and their application as well as techniques. Must have experience in analyzing and testing communication receivers and transmitters, and should be thoroughly familiar with HF and UHF antennas and associated propagation problems. A background in digital equipment; encoder, decoder and magnetic storage devices is an important consideration.

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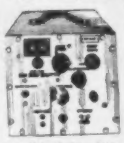

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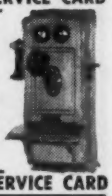

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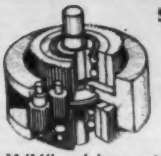

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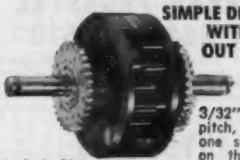

1:1 reverse ratio spur gears are aluminum, 3/32" face, 32 pitch, 32 tooth on one side, 48 tooth on the other. The body is ¾" thick, but the sun gears are spaced out so that they are 1½" apart. ¼" dia. shaft on each side is 23/32" long. OA length 3⅛". Requires 1-23/32" dia. to clear the body.
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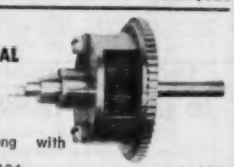

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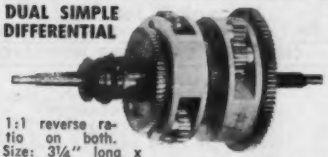

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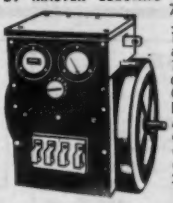

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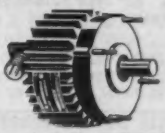

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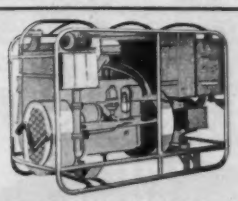

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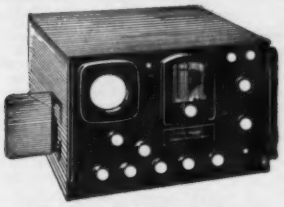

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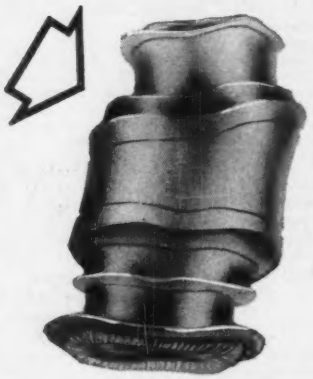

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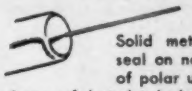

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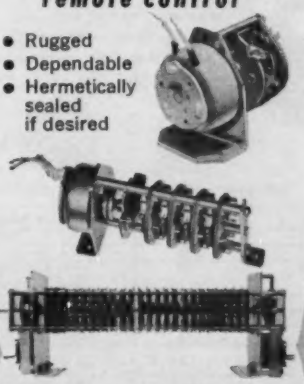

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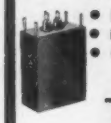

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TI-12	255	1MH to 30Hy
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TI-4	195	5MH to 5Hy
TI-5	130	5MH to 2Hy
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TI-2	285	1MH to 500MH
TI-6	279	1MH to 400MH
TI-7	200	.500MH to 200MH
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MGA 3	Pri. 600 Split Sec. 135,000 C.T.	Input	90003	TF4RX10AJ001
MGA 4	Pri. 600 Split Sec. 600 Split	Matching	90002	TF4RX16AJ001
MGA 5	Pri. 7,600 Tap @ 4,800 Sec. 600 Split	Output	90004	TF4RX13AJ001
MGA 6	Pri. 7,600 Tap @ 4,800 Sec. 4, 8, 16	Output	90005	TF4RX13AJ002
MGA 7	Pri. 15,000 C.T. Sec. 600 Split	Output	90006	TF4RX13AJ003
MGA 8	Pri. 24,000 C.T. Sec. 600 Split	Output	90007	TF4RX13AJ004
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In PRECISION FILM RESISTORS if it's news, expect it first from IRC

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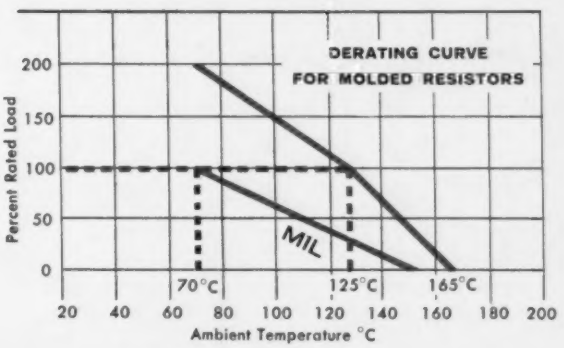
In short, IRC miniaturized Precision Film Resistors run cooler, withstand sudden overloads with little permanent change, and exhibit less change under load than hermetically-sealed resistors costing over 3 times as much.

MIL Type	IRC Type	Length Nominal	Diam. Nominal	Min. Ohms	Max. Ohms	Max. Volts Continuous	WATTAGE		
							MIL 70°C	IRC 70°C	IRC 125°C
RN60	MDA	.406	.130	10	5M	300	⅛	¼	⅛
RN65	MDB	.594	.203	10	5M	350	¼	½	¼
RN70	MDC	.719	.261	5	25M	500	½	1	½



IRC Molded Deposited Carbon Resistors are produced in 3 standard sizes: MDA-¼ watt, MDB-½ watt, and MDC-1 watt, and in resistances from 10 ohms to 25 megohms. Standard tolerance is ±1%, with tolerances of 0.5% and 2% also available. Write for Bulletin B9-6, International Resistance Co., Dept. 373, 401 N. Broad St., Philadelphia 8, Pa.

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- Very high input impedance
- High perveance
- Operation at any altitude at full ratings
- Exceptional uniformity of characteristics from tube to tube
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